SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

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FRIDAY, DECEMBER 27, 1901.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

REPORT OF THE COMMITTEE ON CONVOCATION WEEK.

THE Committee on Convocation Week has continued its work and has secured the allegiance of a large number of important educational institutions to the plan. The proposal has been so generally accepted and has met with such cordial approval that the committee regards its permanent success as secured.

It will be remembered that the first step taken was to communicate to the Association of American Universities, on behalf of the American Association for the Advancement of Science, the proposition to establish the week in which the first of January falls as Convocation Week, to be set aside for the meetings of national scientific and learned societies. The Association of Universities formally recommended by a unanimous vote the adoption of this proposition, and it has since been adopted by nearly all the universities belonging to that association.

A report of the progress made was published by the committee in SCIENCE, N. S. Vol. XIII., p. 641, and in the same journal, Vol. XIII., p. 996, appeared an editorial article advocating the plan for a convocation week, and defining some of its advantages. The Committee has had its report and the

editorial reprinted for its use, and has distributed copies to the governing bodies of numerous universities and colleges.

At its recent Denver meeting the American Association voted to hold its next meeting at Pittsburg, beginning June 28, 1902, but to hold a special meeting of the Council at Chicago during Convocation Week, 1901–02, and to authorize any section of the Association to organize a meeting at the same time and place. This was the first formal adoption of Convocation Week for scientific meetings. The Association further voted to recommend to its present Council to hold a regular meeting of the Association during Convocation Week, 1902–3, at Washington. Since then important advances have been made in the development of the plan in two ways:

First, it is to be reported that Convocation Week this year will be immediately utilized for the meetings of national societies, the following having already voted to hold their meetings during that period:

The Council of the American Association for the Advancement of Science.
The American Society of Naturalists.
The American Morphological Society.
The Association of American Anatomists.
The American Physiological Society.
The American Psychological Association.
The Western Philosophical Society.
The Society of American Bacteriologists.
The Botanists of the Central and Western States.
The American Folk Lore Society.
Section H (Anthropology), American Association for the Advancement of Science.
The American Chemical Society.
The Astronomical and Astrophysical Society of America.
The Geological Society of America.
The Society for Plant Morphology and Physiology.
The American Historical Society.
The American Economic Association.

Second, it is to be reported that the Committee has sent a formal communication to the president of every university, college and technological school included in *Minerva*. The total number of these is 50, to which must be added the fourteen universities which had been previously communicated with, making a total of 64 institutions. The formal communication was addressed to the president or corresponding officer of each institution, and read as follows:

BOSTON, September 15, 1901.

Dear Sir:

The American Association for the Advancement of Science has the honor to request the cooperation of your college in setting aside the week in which the first of January falls as 'Convocation Week' for the meetings of learned societies.

At the New York meeting the Association appointed a Committee, consisting of its President, R. S. Woodward; its Permanent Secretary, L. O. Howard; of Professors J. McK. Cattell and E. L. Nichols, and of the undersigned as Chairman, to take charge of the matter. The Committee presented the plan to the Association of American Universities, which body, at its recent meeting, voted unanimously to recommend the adoption of the plan by the universities. Since then, the following twelve universities, members of the Association, have acted favorably upon the recommendation:

The University of California.
The Catholic University of America.
Clark University.
Columbia University.
Cornell University.
Johns Hopkins University.
Leland Stanford Junior University.
The University of Michigan.
The University of Pennsylvania.
Princeton University.
The University of Wisconsin.
Yale University.

For your further information the accompanying documents are enclosed, both reprinted from SCIENCE. The first gives the general arguments for the proposed 'Convocation Week,' the second indicates the various plans of cooperation adopted by the different universities, all intended to secure the essential point—releasing the teachers of the university from their official duties to enable them to attend the meetings of 'Convocation Week.'

It will give me pleasure to furnish any further information in my power, should you desire it.

Permit me, on behalf of the Committee, to express the hope that your institution will be able to give its support to the project to establish 'Convocation Week,' for we believe that no more important meas-

ure for the promotion of learning in America has ever been proposed.

I have the honor to remain,
Yours, with the highest respect,
CHARLES S. MINOT,
Chairman.
President A. A. A. S.

Harvard Medical School,
Boston, Mass.

Replies, in every case favorable, have been received from the following institutions:

Woman's College of Baltimore.
University of Buffalo.
Case School of Applied Science.
University of Colorado.
Columbian University, Washington.
Hamilton College.
Knox College, Galesburg, Ohio.
Massachusetts Institute of Technology.
Michigan College of Mines.
University of Minnesota.
University of Nebraska.
New York University.
College of the City of New York.
Northwestern University.
Oberlin College.
University of Syracuse.
Tufts College, Boston.
Vassar College.
Wellesley College.
Wesleyan University.
Western Reserve University.
Williams College.

The action has not been uniform, for in a few institutions no change in the vacation was necessary, but several institutions have changed the dates of their vacation to allow the necessary time for Convocation Week to become free. A small minority of the institutions have voted to allow their teachers leave of absence to attend meetings during Convocation Week. Almost every reply has included an expression of cordial approval of the plan.

The Committee hopes to continue and extend its correspondence with those universities and colleges which have not yet taken action, and to be able later to report their adhesion.

The facts above reported seem to the Committee to justify the expectation that the proposed Convocation Week will be permanently established through its formal acceptance by all the leading higher educational institutions of the country.

CHARLES S. MINOT, *Chairman*,
R. S. WOODWARD,
E. L. NICHOLS,
L. O. HOWARD,
J. McK. CATTELL.

A CENTURY OF PROGRESS IN ACOUSTICS.

IN selecting the 'Progress of Acoustics,' on its experimental side, as the subject for this year's presidential address, I am fully alive to the fact that this branch of science has been comparatively neglected by physicists for many years, and that consequently I cannot hope to arouse the interest which the choice of a more popular subject might command. It is, however, just because of this neglect of an important field of science that I conceive it to be my duty to direct some attention thereto. This duty I can best perform, it seems to me, by taking a survey of the work accomplished in this particular field during the century that has just closed. Such a survey will make it evident not only that the science of acoustics has made immense progress during that time, but also that many of the experimental methods in use in other branches of physical science were invented and first employed in the course of acoustical research. This latter fact, though not generally recognized, furnishes an illustration of the interdependence which exists between the various branches of physical science, and suggests the probability that the work of acoustical research in the future may be advanced by experimental methods specially designed for investigation in other fields. A revival will, of course, come in time for acoustics, as it has recently come for electricity, and it ought to come all the

sooner because of the cooperation which physicists may naturally look for from those who are cultivating the new fields of experimental psychology.

In order to avoid the tedium of a bare enumeration of discoveries arranged chronologically, I propose to refer in the first instance to the invention of the various experimental methods which have been employed in acoustical research. A separate reference to these methods will enable us to appreciate their potency in the advancement of this science.

The earliest of these methods is due to Chladni, whose work, 'Die Akustik,' appeared in the form of a French translation in 1809, under the title 'Traité d'Acoustique de Chladni.' In this work were collected all the researches on the vibrations of bodies which Chladni had conducted with the aid of the new method (méthode de sable). This method consists in distinguishing, on the surfaces of vibrating bodies, the parts which are vibrating from the parts which are in repose, by means of the sand which is driven from the former to collect on the latter. In these experiments of Chladni on plates, etc., the violin bow was used for the first time to produce the necessary vibrations. The bow had previously been used only for vibrating cords, the 'violon de fer,' and other musical instruments. Chladni made his discovery of sand figures in 1787, having been led thereto by Lichtenberg's discovery of electric figures.

The transversal nodal lines given by Chladni's method in the case of rods vibrating longitudinally were readily explained. Not so, however, the complicated nodal lines presented by vibrating plates, or the alternate lines which appear on the two sides of rods vibrating longitudinally, and which sometimes also appear on rods vibrating transversally. It was not until 1833 that an explanation of the former of these phenomena was offered by Wheatstone's theory that the nodal lines were due to the superposition of transversal vibrations, corresponding to sounds of the same pitch coexisting with respect to different directions in the plate. This theory was confirmed experimentally in 1864 by Rudolph Koenig, who constructed rectangular plates giving unison notes corresponding to different sets of nodal lines parallel to two adjacent sides of the plate. The theoretical figure results when the plate is vibrated so as to produce the coexisting unison notes.

The alternate nodal lines given by vibrating rods were also explained by the theory of the coexistence of two sounds near unison in the same vibrating rod. In this case, however, one sound corresponds to longitudinal, and the other to transversal vibrations. This explanation was first given by Augusta Seebeck in 1849, whose theory was confirmed in 1859 by Terquem in a very important paper 'Sur les vibrations longitudinales des verges libres aux deux extrémités.'

In 1807, five years after the publication of Chladni's 'Akustik,' appeared Dr. Thomas Young's 'Course of Lectures on Natural Philosophy and the Mechanical Arts' in which we find the earliest description of the graphical method, including its application to chronography. This description is as follows:

"By means of this instrument we may measure, without difficulty, the frequency of the vibrations of sounding bodies, by connecting them with a point which will describe an undulated path on the roller. These vibrations may also serve in a very simple manner for the measurement of the minutest intervals of time; for if a body, of which the vibrations are of a certain degree of frequency, be caused to vibrate during the revolution of an axis, and to mark its vibrations on a roller, the traces will serve as a correct index of the time occupied by any part of the revolution, and the motion

of any other body may be very accurately compared with the number of alterations marked, in the same time, by the vibrating body.'' Notwithstanding the clearness of this description, the graphical method remained for a long time unknown, and when it was developed later, in 1862, the original discovery was incorrectly attributed to Wilhelm Weber (1830). Between these dates slight applications of the method had been made by Savart, Duhamel, Lissajous and Desains, Wertheim, and others; the most important of such applications being that of Scott, who in 1858 applied it to his phonautograph. Finally, from 1858 to 1862, Rudolph Koenig devoted himself specially to the perfecting of this method, and exhibited the results of his labors at the Exhibition in London in 1862, in the form of a large collection of phonograms. This collection in its seven sections comprises all the applications of the method which have so far been made in acoustics. Whilst the progress of this method was thus slow before 1862, its use from that time onward became general, especially in physiological researches, in connection with which it received its widest development in the publication by M. Marey of his splendid work, 'La méthode graphique' in 1878. Parenthetically I might remark that Edison's phonograph (1877) was doubtless suggested by Scott's phonautograph.

As with the graphical method, the earliest suggestion of an optical method of studying vibratory movements came from Dr. Thomas Young, who in 1807 gave the construction of curves resulting from the composition of two rectangular vibratory movements. The practical realization of these curves was effected in 1827 by Wheatstone in his kaleidophone. The most important advance, however, in the development of this method was made by Lissajous, who, after some preliminary work in 1855, published in 1857 his great paper entitled 'Mémoire sur l'étude optique des movements vibratoires.' The optical effects produced by Lissajous' method, especially when the curves were projected on the screen, were so beautiful that the method obtained general recognition, and became immediately popularized. The chief merit of the method, however, does not lie in the beauty of the effects thus obtained, but rather in the fact that by this means we are enabled to determine with facility and with the utmost accuracy both the interval and the difference of phase between two vibratory movements. It is this fact which renders the optical comparator one of the most important instruments at the disposal of the acoustician.

A second optical method we owe to Biot, who in 1820 showed that the changes in density at the nodes of a transparent body vibrating longitudinally could be exhibited when the nodal line of the body is placed between the crossed mirrors of a polarization apparatus. During the continuance of the vibrations the image is highly illuminated in the analyser and becomes darkened when the vibrations stop. This method was developed much further by Kundt in 1864, and by Mach in 1873.

A third optical method was devised by Toepler and Boltzmann in 1870 for the purpose of exhibiting the changes which take place at a nodal point of a vibrating column of air. This method consists in producing interference bands by means of two rays of intermittent light from the same source, one of which passes through the air in its normal state, and the other through a nodal point of the vibrating air column. A vibratory movement of the interference bands results—a movement which can be made as slow as we please, thus rendering it possible to deduce by stroboscopic methods exact measurements as to the movement of the air at the nodal point.

The object of the method of manometric

flames, invented by Rudolph Koenig in 1862, is to furnish an ocular proof of the variations in density at a point of the air traversed by waves originating in another body or in the air itself. A short description of the first apparatus based on this method appeared in Poggendorff's *Annalen* in 1864. Between that year and 1872 the method was applied to a series of instruments, the experiments being described in the same journal in a long memoir entitled, 'Les flammes manométriques.' Although this method is extremely sensitive and capable of furnishing very accurate results, it has been prevented for a long time from rendering more efficient service on account of two causes: first, the want of sufficient brightness in the reflected images of the jumping flames, and second, the difficulty of observing the details of these images owing to their momentary appearance in the mirror. The former of these difficulties has now been overcome by the employment of acetylene and other gases, which at the same time allow admirable photographs of the flames to be taken, thus obviating the second difficulty also. We owe an important paper on this subject to Professors E. L. Nichols and Ernest Merritt published in 1898 in the *Physical Review*.

In 1865, Kundt published his method of using light powders for the purpose of exhibiting the vibratory character of stationary air waves in columns and plates of air. During the existence of these vibrations the light powders arrange themselves in transversal striæ which collect around the loops, and are wanting at the nodes. As in the case of the nodal lines on Chladni's plates, a satisfactory explanation of these striæ was for a long time wanting. In 1890 Professor Walter Koenig showed, from hydrodynamical considerations, that the particles of the powder necessarily arrange themselves in planes at right angles to the direction of the vibratory movements, and that their observed distribution at the loops and nodes is in accordance with the same laws.

Before the invention of the preceding methods the acoustician occasionally resorted to the device of deducing the vibrations of a sounding body from the behavior of a similar body whose movements were of sufficient amplitude to be seen by the eye, and so slow that they could be readily counted. In this way Mersenne counted the vibrations of a cord 15 feet long under a stretching force of 7 pounds, and found them to be 10 per second. In shortening the cord to $\frac{1}{20}$ of its length, he obtained an audible sound whose pitch, he concluded, corresponded to 200 vibrations per second. In the same way Chladni employed a long and thin metal rod, which gave in the first instance only 4 vibrations per second. He then shortened the rod until it gave an audible sound whose pitch he determined from the law expressing the relation between the length and the number of vibrations. This method, however, which appears so simple in theory, is subject to large errors and gives in practice very poor results.

Mersenne's and Chladni's method has accordingly given place to another—the stroboscopic—which allows the vibrations of the sounding body to be viewed directly, its movements relatively to a vibrating eyepiece being rendered as slow as we please. The first use of stroboscopic discs for the purpose of observing very rapid periodic movements was made by Plateau in 1836. His discovery, however, remained unnoticed, for Doppler, in 1845, published a note on the same subject, without referring to Plateau's discovery. It was Toepler who first made the method generally known by employing it in a series of acoustical experiments which he published in Poggendorff's *Annalen*, Volume 128. In the earlier applications of this method, the view of the vibrating body was rendered intermittent by looking through slits which were opened

and closed in rapid succession. This plan was modified by Mach who caused the vibrating body to be illuminated by intermittent light.

If now we allow the stroboscopic images of a moving body to fall on a photographic plate, giving the plate a movement of translation which is arrested before each appearance of the image, we thereby obtain a series of photographs of the successive positions assumed by the body. If, further, matters are so arranged that the beginning and duration of the phenomenon are traced on the images, we have a new method, which is called chronophotography. It was M. Janssen who first conceived the idea of taking automatically a series of photographic images in order to determine the successive positions at different times of the planet Venus in its passage across the sun. It was Janssen also who, in 1876, first suggested the idea of applying successive photograms to the study of animal locomotion. The analyzing of such movements was first accomplished by Muybridge, of San Francisco. The method has been largely extended and perfected by M. Marey, who has employed it in studying the locomotion of all sorts of subjects, from men to insects.

The last of the methods to be noticed is that employed by Rudolph Koenig in his wave-siren. In this instrument a metal band or disc with curvilineal edges passes before a narrow slit from which issues a current of compressed air. By means of these discs we can produce either simple sounds, or sounds of various timbres, containing such harmonics as we please, the intensities and phases of the latter being varied at will. The first wave-siren was constructed in 1867, and the account of the first series of experiments was published in 1881.

The mere enumeration of the methods of acoustical research which have been devised since the days of Chladni is an indication of the enormous advances which have been made in this branch of science. It remains now to state more particularly what these additions to our knowledge of acoustical phenomena have been. This can be most conveniently done under the following heads, viz.: The velocity of sound; its pitch, intensity and timbre; and the phenomena produced by the coexistence of two or more sounds.

THE VELOCITY OF SOUND.

Long before the beginning of the last century it had been observed that the propagation of sound was not instantaneous. Mersenne in fact had tried to estimate the velocity by experiments on echoes, and by counting the time which elapses between the flash of a gun and the report. The latter experiments were also repeated by Kircher as well as by the Academy of Florence in 1660. The same experiments were subsequently, in 1738, undertaken by members of the Academy of Sciences at Paris, by savants, such as Kaestner, Benzenberg, Goldingham and others, but the results obtained did not gain the confidence of the scientific world. A new series of experiments was accordingly undertaken in 1822, on the suggestion of Laplace, by members of the Bureau des Longitudes, to determine the velocity in air and other media. These experiments, which were the beginning of truly scientific work in this subject, were performed by Prony, Arago, Mathieu, A. de Humboldt, Gay-Lussac and Bouvard, between Montlhéry and Villejuif, cannon being fired at both stations. The result obtained was 331 m. at zero temperature, with an increase of 0.6 m. for each degree above zero. In the course of these experiments it was observed that the cannon fired at Villejuif were all distinctly heard at Montlhéry, whilst the reciprocal reports were so faint that only a

small number were heard. Tyndall long afterwards, in 1875, explained this curious phenomenon, attributing it to the existence at Villejuif of a heterogeneous atmosphere, caused by the heated air which came from Paris.

Since the memorable experiments of the Bureau des Longitudes of Paris, various individuals have from time to time undertaken to solve the same problem. Among these may be mentioned Moll and van Beck (at Utrecht), Gregory Woolwich, Stone and Captain Perry in his voyages to the polar regions in 1822, 1824, and Kendall in the Franklin expedition in 1825. In some of these experiments the temperatures ranged from 2° to — 40°, the results obtained according with the theoretical values. In 1823 Stampfer and Myrback conducted experiments between two stations in the Tyrol at a difference of level of 1,364 m.; a similar experiment being undertaken in 1844 in Switzerland by Bravais and Martin with a difference of level of 2,079 m. Both experiments confirmed the law that the velocity of sound in air is independent of the pressure.

In all these experiments the exactness of the results was affected by the difficulty of estimating accurately the time between the perception of the flash and that of the report. Different observers of course gave different estimates. This source of error was first eliminated by Victor Regnault, who in his long series of researches between 1860 and 1870 made use of the graphical method and electric signals to measure time intervals. Regnault's experiments were conducted in seven tubes (part of the Paris sewers) varying in length from 70 m. to 4,900 m., and of diameters from 0.11 m. to 1.10 m. Experiments were also conducted in the open air by means of reciprocal shots fired from two stations at a distance of 2,445 meters. The number of shots fired was 334. These researches of Regnault represent such an enormous amount of work that I shall attempt to give only the principal conclusions deducible from them:

1. In a cylindrical tube the intensity of the wave varies, diminishing with the distance. The narrower the tube, the more rapid is the diminution.

2. The velocity of the sound decreases as the intensity diminishes.

3. The velocity approaches a limiting value, which is higher, the greater the diameter of the tube. The mean value in dry air at 0° in a tube of diameter 1.10 m. is 330.6 m.

4. The velocity is not affected by the mode of producing the sound wave.

5. The velocity in a gas is independent of the pressure.

6. The ratio of the velocities in air and any other gas is $\sqrt{\frac{1}{\partial}}$, where ∂ is the density of the gas, supposed perfect.

7. The average of the results of all the experiments in the open air is 330.7 m. at 0°.

Regnault was also the first to attempt direct experiments for determining the velocity of musical sounds. In this case, however, the electric signals and the graphical recording apparatus were not sensitive enough to respond to the front of the wave, and it became necessary to resort to the ear alone. In these experiments Regnault had the cooperation of Koenig as observer, with whose assistance it was shown that:

1. A note does not change sensibly when it traverses long distances in tubes of large diameter.

2. When the sounds are observed by the ear the velocity of high notes appears to be less than that of low ones. This may be due to the more ready response which the tympanum makes in the case of low notes.

3. In traversing tubes of great length, a

note does not preserve its timbre, being resolved into simple components.

Regnault's experiments have recently been repeated by M. Violle in the large sewers near Grenoble and Argenteuil, some of Regnault's apparatus being employed for the purpose. The results of these experiments have not, however, been yet published.

PITCH.

Before the last century, as already mentioned, Mersenne had attempted to determine the vibrations of a cord by deducing them from very slow vibrations of the same cord when lengthened. Cheadni's tonometer, which consisted of a vibrating metal rod of variable length, was based on the same principle. In 1819 Cagniard de la Tour invented the siren, a much superior instrument, but incapable of giving very exact results, notwithstanding the simplicity of its mechanism. The same remark may be made of the toothed wheel invented by Savart in 1830.

A most important step in advance was made in 1834 by Henri Scheibler, of Crefeld, who in that year invented his tonometer, consisting of a series of 56 forks going from A (440) to its octave (880), the vibrations increasing regularly by differences of eight, any two adjacent forks thus giving four beats per second. Curiously enough, although Scheibler went to Paris and exhibited his tonometer there, he was unable to interest savants in his discovery; and it was not until the London exhibition of 1862 that the attention of physicists and musicians was directed to the value of the instrument by Koenig. The apparatus in its new form contained 65 forks going from C_3 (512) to C_4 (1024).

Notwithstanding the great utility of this tonometer to the acoustician, it still left undetermined the absolute pitch of the fundamental note, and hence of the whole series. This problem of realizing a standard of pitch remained practically unsolved, even after the French Government in 1859 decreed that the standard should be A = 870 v. s., at 15° C. The standard then constructed by Lissajous was found, in 1880, to be too high by $\frac{9}{10}$ of a vibration. The standard employed since 1880 by Koenig is C = 512 v. s. at 20°. The acoustical standard before that date was in reality 512.35 at 20°. The problem of realizing a standard fork, which had given rise to much controversy among physicists, was finally solved in 1880 by Koenig, who in that year published his paper 'Recherches sur les vibrations d'un diapason normal.' In this paper Koenig describes how by means of a clock-fork (horloge à diapason comparateur) he established a standard fork, the error of which did not exceed $\frac{1}{6000}$ of a vibration. The clock-fork method enables us at the same time to determine readily the variations in the number of vibrations due to a rise or fall of temperature. Having established in this way an absolute standard of C_3 = 512 v. s. at 20° C., Koenig commenced the construction of a universal tonometer based thereon, a colossal undertaking which he finished in 1897, after working a score of years. This tonometer, which has a range from 32 to 180,000 v. s., consists of the following:

1. 4 forks giving vibrations from 32 to 128, with differences at first of $\frac{1}{2}$ v. s. and afterwards of 1 v. s.

2. 132 large forks, tuned to give (without the sliders) the 127 harmonics of C_1, C_2, C_3, C_4, C_5, C_6, being in duplicate.

Each fork can be lowered, by means of sliders, to unison with the fork next below.

The differences immediately obtainable by sliders are:

1 v. d. between C_1 and C_3; 2 v. d. between C_3 and C_5; 4 v. d. between C_5 and C_7.

3. 40 resonators to reinforce forks of 2.

4. One large resonator of diameter 0.48 m. and of length varying from 0.30 m. to 2.30 m.

5. 18 forks for notes from C_1 to F_3.

6. 15 forks for notes from Sol_3 to 180,000 v. s.

Under the head of pitch come two very difficult questions relating to the audibility of very low or very high sounds. With regard to the former Helmholtz has shown that if the vibrations are very slow and do not follow the pendular law (the fundamental being thus accompanied by a series of harmonics), the fundamental may be quite inaudible, whilst the harmonic is heard distinctly. In such a case the harmonic is often mistaken for the fundamental. On the other hand, if we employ large tuning forks, vibrating rods, or the wave siren, for the purpose of obtaining pendular vibrations, we are still met with the difficulty of determining accurately the limits of audibility, owing to the fact that it not only depends on the intensity of the vibrations, but varies from one observer to another. In general it may be stated that it requires from 60 to 80 v. s. to produce a sound perfectly continuous and possessing a musical character. In using very powerful high forks to produce beats, which were gradually diminished in number, Koenig found that the sensation of a continuous low sound ceased when their number did not exceed 26.

As to the high notes above $C_7 = 8,192$, the amplitudes of the vibrations are generally so small that the ordinary methods no longer serve to determine the pitch. For this reason it was at first the practice to tune forks above C_7 by means of the ear. The high forks constructed by Marloye and presented to the Academy of Sciences at Paris, in 1848, by Depretz, were constructed in this way. In 1858, however, Koenig showed that even in the upper half of the octave $C_8 - C_7$, the best musicians ceased to judge the intervals accurately, a fact which seemed to show that it was extremely unlikely that forks giving notes two octaves higher could be tuned accurately by the ear. For this reason Koenig effected the tuning of very high forks by means of the sounds resulting from their beats. The first series of forks tuned in this way were made by Koenig in 1876. A set of similar forks constructed about the same time by Preyer, and going, as he alleged, as high as E_{10} were shown by Melde, in 1894, to be greatly out of tune, the intervals being wrong by as much as a third, and even an octave. In 1897, Melde's results were confirmed by Stumpf and Meyer.

In 1899 Koenig published his researches on very high notes. In this memoir, after showing the exactness of the tuning attained by the sounds of beats in forks between C_7 and F_9, he proceeds to state that, by means of Kundt's method of using light powders, he had constructed a series of high forks accurately tuned and proceeding according to the intervals of the perfect (major) scale, from C_7 to the enormous pitch of 180,000 v. s., and that without reaching a limit to the number of such vibrations.

As to the audibility of these high forks, it has been remarked by Koenig that those between C_7 and C_9 are generally audible, whilst C_{10} and those above are entirely inaudible. He further remarks that the limit of audibility, which thus lies between C_9 and C_{10}, largely depends, as in the case of low sounds, on the intensity, and varies with the individual.

INTENSITY.

With regard to the question of intensity of sound, it is only necessary to say that there exists here a great lacuna in our acoustical knowledge, as we do not yet possess a means of measuring the physiological intensity of sound.

TIMBRE.

To Helmholtz belongs the credit of first elucidating the question of timbre by showing that the timbre of a sound depends upon the number and intensity of the harmonics accompany the fundamental. The question of timbre is thus intimately connected with the study of the phenomena produced by the coexistence of two or more sounds. With regard to such phenomena, it was stated by Helmholtz that when two notes of different pitch are sounded together, they give rise to two other sounds, the pitch of which is measured, the one by the difference, and the other by the sum of the vibrations of the two primary sounds. Further, that these resultant sounds are not due to beats.

These propositions of Helmholtz are controverted by Koenig, who, on the contrary has proved that the sounds actually heard accompanying two primary sounds are always due to beats. Koenig asserts, moreover, that the sounds referred to by Helmholtz, even if we could prove that they had a real existence, would always be inaudible, and therefore without effect on the acoustical phenomena. He further establishes the curious fact that even interruptions of a sound give rise to another sound.

As to timbre, Helmholtz's theory was that it depended solely on the number and relative intensities of the harmonics which accompany the fundamental, and that it is not affected in any degree by differences in the phases of these components. This latter proposition is combated by Koenig who holds that differences of phase as regards harmonics exercise a very important influence on the timbre of a sound, so that according to him timbre depends on the number, relative intensities and differences of phase of the harmonics which accompany the fundamental. Koenig's experiments on this disputed point were performed with his large wave-siren. Even this wider definition of timbre is, however, according to Koenig's most recent view and experiments, insufficient, as not being applicable to certain classes of timbres—for example, those produced by most musical instruments, especially stringed instruments. In these cases the fundamental is accompanied not only by harmonics, but also by other sounds which are not harmonic, the superposition of which produces series of waves which change their form successively. These wave forms have been investigated by Koenig in a paper, 'Sur les timbres à ondes de formes variables,' in which he determines the conditions under which such timbres may be considered musical, and concludes that in these cases the fundamental is accompanied by harmonics which continually change their relative intensities and their phase-differences.

In conclusion I may state that, according to Koenig, the fact that differences of phase amongst harmonics produce differences of timbre is explained for the first time by his recent discovery that the intensity of a sound can be increased by the addition of another sound, when the maxima of intensity in the vibrations in the two cases correspond more or less exactly, and that several sounds produced together may reinforce a sound of lower pitch than any of them. For example with the same six primary sounds, by changing their phases only, he produces not only timbres differing in intensity and in richness, but timbres in which, at one time, the octave (2) and at another time the fifth above (3) are heard. The difference between these two timbres is, indeed, so great that when heard in succession, there appears to be an interval of a fifth between them, although their fundamentals are exactly the same. These experiments may be said to be the last on this difficult subject in the years of the century which has just closed.

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*CURRENT QUESTIONS IN ANTHROPOLOGY.**

No idea is more firmly fixed in the mind of the average man than that of monogenesis—*i. e.*, the idea that all mankind sprang from a single pair, and hence came up in a single center. Nor is the prevalence of the idea surprising; engendered by the associations of family life, fostered by honorable regard for worthy ancestors, and nourished by tradition, it grows into a natural intuition; and when intensified by the teachings of biology (whence most modern thinkers derive early lessons), it readily matures in a postulate so simple and so strong that few anthropologists take the trouble to question its validity. Yet once the question is raised, the postulate is seen to be gratuitous; in the present state of knowledge it may not be either affirmed or denied with confidence; but it must be recognized that the intuitive idea of monogenesis is not supported by a single observation in the domain of anthropology, and is opposed by the great body of observations on human development. The first corollary of the monogenetic postulate is that mankind differentiate—that they differentiated in the beginning, that they are differentiating now, or that they differentiated at some intermediate stage, one or all; in any event, that the course of human development is one of progressive differentiation. Of course, if the postulate were a direct inference or a generalization, this mode of statement would be reversed; in that case it would be necessary to say that certain observed facts of differentiation lead to an inference of differentiation in general, and point to a law of monogenesis; but it cannot be too strongly emphasized that the notion of monogenesis in the human realm does not represent observation, generalization, inference or other inductive procedure from fact to interpretation—it is a pure assumption, imported into anthropology from other realms of thought, introduced as a full-grown foundling, and ever at war with the legitimate offspring of the science of man.

The great fact attested by all observation on human development, and susceptible of verification in every province and people, is that mankind are not differentiating in either physical or psychical aspects, but are converging, integrating, blending, unifying, both as organisms and as superorganic groups. The population of the world is steadily increasing, but the number of races is not; while the number of distinct peoples is progressively decreasing and the racial boundaries are slowly but surely melting away. This present condition is in accord with the past so far as history runs; races have not come up, tribes have not multiplied, but distinct peoples have coalesced, dialects and languages have blent into common tongues, throughout the known world—indeed, the processes of integration have been so characteristic of human progress throughout the historical period that it is now possible to enounce, if not to establish, the proposition that peoples are preeminent in proportion to the complexity of their blood and culture. These salient facts of the present and of the recorded past fall naturally into a generalization of integral or convergent development, which in turn points toward a hypothesis of polygenesis. The major indications are supported by minor ones too numerous for easy counting; and the burden of the testimony is amply sufficient to compel the open-minded anthropologist to tolerate the polygenetic hypothesis, if not to accept it as a working platform alternative with that of the monogenesis so long yet so gratuitously assumed.

Several students, like Keane in recent publications, have, indeed, held that the black, brown, yellow and white races cannot have sprung from common parents;

* Abstract of address before Section H, Denver Meeting, American Association for the Advancement of Science.

yet it may be questioned whether even this position is not merely a stepping-stone toward a more general view of humanization beginning with many varieties of the unknown prototype in different regions, coming up through the multifarious tribes of scientific record, and approaching the dominant types of to-day. Certain it is that when a race or congeries of tribes measurably similar in physical features—*e. g.*, the Amerinds—are considered with respect to the intertribal relations established by record and tradition, their history is found to be one of coalescence, through the growth of stronger groups and the assimilation or elimination of weaker, through the interchange (whether inimical or amical) of artifacts and industrial processes, through more or less frequent intermarriage, through the giving and taking of linguistic elements, through the interchange of custom, faith, ceremony, law and other factors of culture which react on mental and bodily exercise and thus shape development; the interchange and coalescence may be slow and incomplete, as between the Seri and Guayaqui tribes and their respective neighbors, or rapid and comprehensive, as in the Iroquois and Dakota confederacies, yet it is ever-present, and when the lines of development are traced backward they are invariably found to diverge more or less widely and point toward more or less distinctive origins.

What is true of the Amerind tribes in this respect is even more conspicuously true of the African tribes, ranging from the pigmy Akka to the gigantic Zulu and other widely diverse physical and cultural types; most of these tribes, too, have been observed in actual coalescence with their neighbors, while not a single satisfactory indication of differentiation or increasing distinctiveness has ever been detected; so that here, too, the developmental lines traced backward are found to diverge and multiply up to the very verge of the unknown—the prehistoric, or at least the scriptless, past. And what is true of America and Africa is more or less conspicuously true of other continents and other peoples; everywhere the developmental lines converge forward and diverge backward, just as the lines of biotic development diverge forward and converge backward. How this discrepancy is to be removed is a question whose importance increases with every advance in the science of anthropology.

It seems not too much to say that the leading question before the anthropologist of to-day is that relating to the trend of human development and its bearing on the alternatives (postulate and inference, respectively) of monogenesis and polygenesis; for it is easy to see that most of the other questions are affected by this primary one. The definition of race, the discussion of human antiquity and various civil problems of the day are all involved; and while it is too much to hope for general agreement concerning the fundamental question at any early day, it is none the less desirable to note the trend of multiplying facts and observe their steady set toward the inductive hypothesis of polygenesis rather than toward the deductive assumption of monogenesis.

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THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

THE eighteenth convention of the Association of Official Agricultural Chemists held its meetings in Columbian University, Washington, D. C., November 14, 15 and 16, 1901, under the presidency of Dr. L. L. Van Slyke, Chemist of the New York Agricultural Experiment Station, at Geneva. The attendance at this meeting was the largest in the history of the Association, reaching 118 members, representing nearly all the States and Territories of the Union.

A notable change has taken place in the character of the meetings of the Association of Official Agricultural Chemists, which at first was organized chiefly for the unification of methods of the analysis of commercial fertilizers. This branch of the work has now reached such perfection as to require little or no attention. The great work of the Association is now directed to other subjects, especially to investigations, researches and studies of foods and food adulterants.

The two most important events of this meeting were the reports of the committee on uniform methods of food investigation, of which Dr. W. D. Bigelow, of the Bureau of Chemistry, of the U. S. Department of Agriculture, is chairman, and of the committee on food standards, of which Dr. Wm. Frear, of the State College of Pennsylvania, is chairman. Since nearly all the States have pure food laws, it is of the utmost importance, from both a scientific and a legal standpoint, that uniform methods of investigation be followed and that some definite standards may be fixed whereby the court and jury may follow a uniform method in determining variations from the normal.

The officers elected for the ensuing year are Dr. H. J. Wheeler, Chemist of the Rhode Island Experiment Station, Kingston, R. I., president; Professor R. J. Davidson, Chemist of the Virginia Agricultural Experiment Station, Blacksburg, Va., vice-president; Dr. H. W. Wiley, Chief of the Bureau of Chemistry, U. S. Department of Agriculture, Washington, D. C., secretary; Dr. C. G. Hopkins, Chemist of the Illinois Agricultural Experiment Station, Urbana, and Mr. Fred. D. Fuller, Assistant Chemist at the Agricultural Experiment Station of New York, at Geneva, additional members of the executive committee.

The next meeting of the Association will be held in Washington, at the call of the executive committee, probably in November, 1902.

H. W. Wiley.

SCIENTIFIC BOOKS.

Tierleben der Tiefsee. Von Oswald Seeliger, Professor der Zoologie an der Universität Rostock. Leipzig, Verlag von Wilhelm Engelmann. 1901. Pp. 44.

While it can hardly be claimed that this work is a distinct addition to our knowledge of deep-sea life, it nevertheless serves an important purpose in presenting a compact resumé of the more notable facts relating to the animals of the deep and the conditions under which they exist. The author has been fortunate in his method of treatment, which is popular rather than technical, and covers the field as well as could reasonably be expected in the space occupied. There is hardly any 'padding,' and the more technical parts of the work are wisely segregated under the heading 'Anmerkungen' at the end.

An introductory sketch of the development of deep sea investigation, from the ancient pearl fisheries of the Indian Ocean to the recent German deep-sea expedition, includes notices of the work of John Ross, Edward Forbes, Michael Sars, Lovén, the cable surveys and the resultant discoveries of animal life in abyssal regions, and the expedition under the direction of the naturalist Chun. It is, to say the least, unexpected to find no mention whatever of such notable expeditions as those of the *Porcupine*, *Challenger*, *Travailleur*, *Blake* and *Albatross*. A similar surprise awaits the reader who peruses the pages devoted to a description of methods and instruments of deep-sea research without finding the slightest mention of the many instruments of precision invented by British and American investigators, such as Sir William Thomson, Alexander Agassiz, Professor Brooke, and Captains Sigsbee and Tanner of the U. S. navy.

The discussion of the physical conditions of the deep sea includes a presentation of the more important facts regarding temperature, but presents to greater length the matter of pressure. The author estimates that the total pressure exerted on a human body, if sunk to a depth of 4,000 m., would equal the weight of ten loaded freight trains, each consisting of an engine, tender and 32 cars. The American reader should remember, however, that these are con-

tinental, and not American trains. As a matter of fact, this pressure has little effect on the organisms inhabiting the depths on account of their being themselves so largely composed of and permeated by sea water. But the release of pressure experienced by individuals suddenly transferred from deep to shallow water is most disastrous in its effects, as illustrated by the fate of deep-water fishes when brought to the surface.

In discussing the chemical composition of sea water the author states that the oxygen is derived from the atmosphere, and that the carbonic acid increases with the depth, and that this latter fact explains the lighter calcareous skeletons of deep-sea forms as compared with their shallow-water relatives. On the other hand, silicious skeletons from great depths are proportionately heavier than those from shallow water, although actually smaller. In this connection the point might well be raised that the heavier calcareous skeletons are not needed in the depths for weight or protection against waves or currents, and that their comparative fragility could be accounted for on other grounds than the solvent action of carbonic acid.

The problem of the penetration of sunlight is treated at considerable length. This subject has been made a matter of investigation by means of experiments with sunken photographic plates, the greatest depth at which even the most sensitive are in any degree affected being 500 to 550 m., according to Fol and Sarasin. Red rays, however, might still be present without affecting the photographic plates, and the reddish yellow twilight of Agassiz and Haeckel might result.

Professor Seeliger denies the red-light theory, and maintains that the blue or blue-green rays penetrate most deeply. He substantiates his argument by an ingenious reference to the well-known and beautiful illumination of the famous 'Blue Grotto' of Capri, where the light penetrates a considerable depth of sea water and is reflected upward into the cave. Spectroscopic investigation confirms this blue-light theory, which appears to be now well established by the arguments here recorded. The author believes that no light from the sun reaches the greater depths, and says that no conditions of existence in the deep sea have so strongly influenced the organization and manner of life of animals as the absence of sunlight and heat.

The coloration of deep-water forms is regarded as protective in the main. In explanation of the red color so often found, the claim is made that this color would be protective, on account of its being inconspicuous in a blue light. This point is debatable, in the opinion of the reviewer, as any neutral tint would be just as inconspicuous as red, and thus the utterly useless production of such quantities of bright pigment be avoided. After noting the frequency of dark-colored or black hues among the abyssal fishes, and the contrast between this rich pigmentation, on the one hand, and the bleached, often colorless condition of cave animals on the other, the author fails to grasp the significance of the contrast. He doubts the effective presence of attractive coloration as an aid to sexual selection in the deep 'wo die tiere gar nicht oder nur unvollkommen sehen' (*sic!*). Indeed the discussion of the coloration of deep-sea forms is the most unsatisfactory part of the work.

The loss of sight in abyssal animals is frequently compensated for by the special development of other organs, usually tactile, such as the extremely elongated spines of certain fishes, the immensely lengthened antennæ of crustaceans such as *Nematocarcinus gracilipes* and *Sergestes magnificus*. Such structures are often coordinated with degenerate eyes. Sense hairs are sometimes greatly developed in deep-sea annelids and on the lengthened legs of certain crabs.

The author claims that a light, aside from that of the sun, is found in the depths in the form of phosphorescence, and this he discusses in a very interesting manner. The fisherman at night draws up his net filled with 'tausenden glühender Fünckchen.' The light-emitting forms increase in the deeper waters, "Hier finden sich zeitlebens festgeheftet am Meeresgrund lebhaft phosphorescierende Rindenkorallen, stark bläulich leuchtende Seefedern. Hier leben zahlreiche leuchtende Würmer und Protozoen, prächtig glühende Seesterne (*Brisinga*) und Cephalopoden."

Light-producing organs may be found, often in great numbers, in various parts of the body. Often such organs are coordinated with eyes, and in some cases—*e. g.*, *Ipnops**—the eye itself has become degenerate and replaced by a phosphorescent organ. Among the crabs, as well as fishes, the light-emitting organs serve as dark-lanterns to illuminate the immediate surroundings, and also as lures to attract the prey. The author claims that there is, in general, a decreasing degeneration of the eye with increasing depth. In *Ethusa granulata*, a crab, specimens from shallow water have good visual organs, while those from 900 to 1,300 m. are usually blind. It appears to be a fact that the eyes of deep-sea forms tend either to a great increase in size, on the one hand, or degeneration on the other, as ordinary eyes are of little use in the depths.

The possession of light-emitting organs in blind animals is explained on the ground of utility in terrifying hostile animals or alluring the prey.† There are also instances in which very similar light-producing organs have been developed by widely differing animals by a process of approximation.

In discussing the systematic relationships of deep-sea animals the author states that they do not differ among themselves more than do shallow-water forms. It was at first thought that the abyssal region would yield many ancient types, and, indeed, this is in a measure true. It appears that the older forms were often driven to the depths to escape competition with newer and more specialized rivals. Many deep-sea sponges and echinoderms resemble cretaceous and jurassic types. It can be stated as a generalization, however, that deep-water animals are no nearer mesozoic forms than are those from lesser depths. In sustaining this latter claim the author cites the many cases of so-called 'living fossils' among shallow water mollusks, and also the old-fashioned mammals still existing, such as the proboscidians. On the other hand, deep-sea animals can often, indeed usually, be referred to existing genera of shallow-water forms, and the author claims that the former were originally derived from the shallow-water inhabitants of the past. The conditions of life in the abyssal regions are not conducive to developmental changes, neither are they such as to favor the evolution of the organic from the inorganic.

Professor Seeliger, like most other writers on this subject, cannot refrain from having his fling at the '*Bathybius* theory' of Huxley, which was exploded through the chemical researches of Buchanan, who demonstrated that the apparently vital movements of '*Bathybius*' were purely physical.

Our author believes that animal life becomes less abundant in the greater depth, but that there is no zone that is entirely uninhabited, a conclusion directly opposed to the one so thoroughly demonstrated by Alexander Agassiz, who maintains that there is an intermediate zone which is practically lifeless. The argument against the existence of an uninhabited zone is based on considerations affecting the food supply. In shallow water the food basis is largely vegetable, but plant life becomes sparse below 200 m. and practically vanishes below 400 m. But the inhabitants of the underlying zone ascend to what may be called the plant zone for their nourishment, and then retire satisfied to the deep. The bottom-inhabiting species, whether free-moving or fixed, are nourished by the organic substances sinking, in changed form, to the bottom.

The bottom deposits are briefly described as diatom ooze, radiolarian ooze, globigerina ooze and red clay.

The author concludes by emphasizing the intimate connection between the animal inhabitants of the upper and deeper zones, and the dependence of the abyssal forms upon the upper regions for their food supply. The animal world of the deep is in general a reflected rep-

* It should be noted, however, that the eyes of *Ipnops* still appear to be functional, although exceedingly modified to form the immense phosphorescent lantern that occupies about half of the dorsal surface of the head.

† In the discussion of phosphorescence in the deep sea, the conclusions of Professor Seeliger are so nearly identical with those presented by the present writer in the number of SCIENCE issued May 31, 1901, that attention should be called to the note at the bottom of page 852, referring to a previous article on 'The Utility of Phosphorescence in Deep-sea Animals,' published in the *American Naturalist*, Oct., 1899.

resentation (Spiegelbild) of that of the upper waters.

The last sentence in the body of the work is well worth quoting for the beauty and grandeur of the conception involved:

"Denn alles, was oben im Spiel der Wellen und im Sonnenlicht lebt und vegetiert, muss endlich doch noch in irgend einer Form zur Tiefe gelangen, um in der dunklen, von keiner Welle erregten Riesengrabstätte des Meeresgrundes den Kreislauf des Stoffes zu vollenden."

Following the body of the work are twenty closely printed pages of notes of a more technical character, embodying the actual facts which form the basis for the statements and conclusions of the author. These are of real value to those who study more carefully the fascinating problems of the deep.

The work as a whole will form a welcome addition to the library of the general student, and the specialist will find it well worthy his careful perusal and frequent consultation.

C. C. NUTTING.

Agricultural Bacteriology: A Study of the Relation of Bacteria to Agriculture with special Reference to the Bacteria in the Soil, in Water, in the Dairy, in Miscellaneous Farm Products, and in Plants and Domestic Animals. By H. W. CONN, Ph.D. Philadelphia, P. Blakiston's Son & Co. 1901. Pp. 412. Figs. 40.

This is a new book on a new subject. There have been books treating of separate phases of the subject, as dairy bacteriology, but heretofore no book has been issued in English which has attempted to cover the whole range of bacteriology in its relations and applications to agriculture. As the sub-title explains, it has special reference to the bacteria in the soil, in water, in the dairy, in miscellaneous farm products and in plants and domestic animals.

Professor Conn shows that while in the popular mind bacteria have come to be almost synonymous with disease, they are intimately associated with many normal processes which are going on in the soil, water and elsewhere, and are important and very often essential factors in the operations of farming as well as in every-day life: "From beginning to end the occupations of the agriculturist are concerned in the attempt to obtain the aid of these microorganisms when they may be of advantage, and in preventing their action in places where they would be a detriment"; and he adds that "farming without the aid of bacteria is an impossibility." As yet only a beginning has been made in studying their application. In the section on bacteria in the soil, the author shows that they have important relations to agricultural processes in at least five different directions, namely, in the decomposition of rocks, the fixation of free atmospheric nitrogen in the soil, the decomposition of all complex organic bodies and compounds in the soil, the formation of nitrates, and, in connection with the legumes, in reclaiming nitrogen from the air. He prophesies that "in the future the problem of the proper treatment of soil for the use of agriculture will be, in a very large degree, a problem of the proper control of bacteria. Agriculturists must learn to stimulate the bacterial actions which are advantageous, and check those which are disadvantageous, if they would insure the continuance of soil fertility." There is perhaps no phase of agriculture where bacteria play such an important part as in the dairy. It is appropriate, therefore, that this subject, to which Professor Conn has himself been an important contributor, should receive quite extended treatment. The advances made in the control of bacteria in milk, as a result of better understanding of their sources and of pasteurization, have contributed to a better milk supply of cities, as well as to superior quality of the butter produced. The author contends that the introduction of pure cultures for ripening the cream in buttermaking has resulted in improving the general quality of butter and has led to greater care in the preparation of the 'starter' where pure cultures are not employed. The part played by enzymes, especially galactase and rennet, in the ripening of cheese is pointed out, but the author is inclined to ascribe considerable importance to lactic bacteria in this connection. Elsewhere the importance of enzymes in explaining various phenomena formerly ascribed to the direct action of bacteria is discussed at some length. This opens up an interesting

line of study in a field where comparatively little beyond the result is known at present. The book is written in a clear and entertaining style that should commend it to the general reader as well as the student. It is an important addition to our agricultural literature, and will be welcomed by many who have felt the need of a general treatise on the subject.

E. W. Allen.

The Feeding of Animals. By Whitman H. Jordan. New York, The Macmillan Co. 1901. Pp. 450.

This book by the director of the New York State Experiment Station, is the latest contribution to the excellent Rural Science Series. Several books on feeding have been published by American writers, but in some ways this is the most systematic and comprehensive treatment of the subject, especially as adapted to the needs of the student. While the teachings of European experiments and experience are taken account of, American conditions are kept constantly in mind, and this gives the book a distinct advantage over some which have adhered too closely to the German feeding methods. Dr. Jordan has combined a quite thorough review of the important scientific teachings on the subject, with a plain and clear statement of the application of these facts in practical feeding. He has digested the investigation relating to feeding at home and abroad, and gives the reader the benefit of his judgment and insight into the subject in interpreting and applying them. The applications which he makes of the science of feeding to practical conditions show that he is not bound down by any theoretical ideas or teachings but is thoroughly familiar with the standpoint of the practical feeder. He breaks away, in a measure, from the mathematical doses of nutrients prescribed in feeding standards, but at the same time he admits the value of these formulas as an aid in selecting adequate, uniform and well-proportioned rations. The first part of the book is taken up with the principles of feeding, the relations of plant and animal life, the composition and digestibility of feeding stuffs, the function of nutrients and the laws of nutrition; while the second part considers the practice of feeding, the selection and compounding of rations for maintenance, for milk and meat production, for growing animals and for work, as well as questions of general management. The arrangement of the book is logical and orderly, and it is well suited to the needs of the student and the class room; in fact it may quite possibly prove more popular as a text-book than as a manual for the farmer or practical feeder, and for such a text-book there is perhaps the greater need at present.

E. W. Allen.

A Text-book of the Physics of Agriculture. By F. H. King. Second edition. Madison, Wis., Author. 1901. Pp. xvi + 604. Figs. 276.

In this book, which is by the professor of agricultural physics in the University of Wisconsin and physicist of the experiment station, "the aim has been to present to the student who expects to be a farmer some of the fundamental principles he must understand to become successful." The author states that it is his purpose to present these principles from the physical rather than from the chemical or biological standpoint, and from that of the general student and farmer rather than from that of more technical scientific agriculture. Nevertheless, the book will be found to be a notable contribution to the literature of scientific agriculture in a field which has not heretofore received the attention its importance demands. The introduction deals briefly with certain general physical principles, laws and factors, a knowledge of which is necessary to an understanding of their subsequent practical application. Other chapters deal with the nature, origin and waste of soils; chemical and mineral nature of soils; soluble salts in soils; physical nature of soils; soil moisture; physics of plant breathing and root action; movements of soil moisture; conservation of soil moisture; relation of air to soils; soil temperature; objects methods and implements of tillage (especially the plow); ground-water, farm wells, and drainage; principles of rural architecture, including strength of materials (posts, barn frames etc.), warmth, light and ventilation, principles of construction, construction of silos; farm mechanics, including principles of draft, construction and maintenance of country roads, farm motors (animal power, steam and gasoline

engines and windmills); farm machinery (general principles, belting, farm pumps, hydraulic rams); principles of weather forecasting, including discussions of the atmosphere and its movements and weather changes.

W. H. BEAL.

Chemische und medicinische Untersuchungen. Festschrift zur Feier des sechzigsten Geburtstages von Max Jaffe, mit Beiträgen von M. ASKANAZY, P. BAUMGARTEN, M. BERNHARDT, R. COHN, TH. COHN, W. ELIASSOW, A. ELLINGER, J. FROHMANN, P. HILBERT, LASSAR-COHN, D. LAWROW, E. V. LEYDEN, W. LINDEMANN, W. LOSSEN, H. MEYER, E. NEUMANN, H. NOTHNAGEL, E. SALKOWSKI, W. SCHEELE, L. SCHREIBER, A. SEELIG, S. STERN, O. WEISS, R. ZANDER. With 8 plates. Pp. 472. Braunschweig, Friedrich Viewig und Sohn. 1901.

Such volumes as this 'Festschrift' are always of interest in recalling definitely the position and achievements of the scientist to whom they are dedicated, since they come at a time when his great creative work is generally completed. They reveal also something of that side of scientific investigation, unnoticed in the journals and text-books, but of so much importance in the development of thought, the personal relations of the investigators, their influence upon each other, and the inspiration derived by both from the association of teacher and pupil. The papers contributed to volumes of this character are, indeed, frequently distinguished for kindliness of intention, rather than for intrinsic merit. Such is not the case in this volume. Most of the papers are the first presentation of important investigations, which might take their place worthily in any scientific or medical journal. The remaining articles, although presenting no new facts, are interesting on account of the ability and reputation of their writers, and afford suggestive discussions of some of the problems which are of special importance at the present time.

This volume is in every respect a fitting tribute to Jaffe. Although, of course, no word of it was written by him, there is throughout a tone which clearly reflects his influence. The firm grasp of the purely chemical aspects of the problems, even when dealing with clinical or pathological subjects, the definiteness of the problems set before the investigator, and the clearly devised and vigorously executed experiments employed for their solution, show in the pupils the imprint of the teacher; in the friends, the influence of the coworker. It is one of the most hopeful signs for the future of medical investigations that they are adopting from chemistry and physics that habit of measuring without which science would be mere empiricism. If that quality be sought in Jaffe's researches which most entitles them to their place, it would probably be found in the exactness of the chemical methods employed. They are excellent examples of the application of pure chemistry to the problems of biology. Jaffe has rarely left an investigation of the complex organic substances, whose origin or influence in the animal body he has discovered, without having established also their structural formulæ. He seems to possess the even rarer gift of impressing this trait on others.

The contents of the volume are arranged in three parts, of which the first is devoted to clinical medicine. In the opening article, v. Leyden, as the oldest friend and coworker of him in whose honor he writes, reminds the reader that they two were the first to introduce into medicine, as long ago as 1866, the use of oxygen gas. After reviewing briefly the opposition or rather indifference with which this method of treatment was long regarded, especially in Germany, the writer dwells with just pride on the universal acceptance at the present day of the value of oxygen inhalation, not only in cases of morphine, strychnine and carbon-monoxid poisoning, extreme chloroform narcosis and dyspnœa from many other causes, but also as a therapeutic agent in several of the diseases of the respiratory organs. Following this paper are articles by Nothnagel on 'Intestinal Hemorrhages,' Scheele on 'Subphrenic Abscesses,' and Frohmann on 'Primary Sarcoma of the Intestine.' To these are added a report and discussion by Eliassow on 'Three Cases of Degenerative Chorea,' and by Bernhardt three reports upon cases of 'Localized Convulsions in the Upper Extremities,' 'Localized Convulsions in the Lower Extremities,' and 'Infantile Facial Paralysis.' To

this section also Stern contributes an interesting description of a case of 'Traumatic Neurosis and Simulation,' which, after being diagnosed repeatedly by others as simple imposture, the writer was led to regard as the manifestation of real suffering and deficiency. He closes a discussion of the views of Charcot and others on hysteria, hypnotism and allied phenomena, with a plea for a more sympathetic attitude on the part of physicians toward patients so affected.

The second part of the volume is devoted to morphological subjects, and contains an article by Schreiber, which is in the main a review of the recent work on the so-called 'Clasmatocytes' and an investigation of their probable origin and purpose. This is followed by Zander on 'Schistosoma in Man—A Contribution to the Mechanics of Development under Normal and Pathological Conditions,' and Askanazy on the 'Pathology of Bone' in cases of grafting and in the stump of a bone at the point of amputation.

The third and by far the largest part of the volume contains investigations in pure chemistry, physiology, toxicology, experimental pathology and bacteriology. The first of these subjects is represented by Lossen on 'Phthalylhydroxylamin and Related Compounds,' and 'An Improved Nitrometer' by Lassar-Cohn. On the side of physicochemical methods in physiology and medicine, Baumgarten discusses 'Hæmolysis' from the standpoint of the changes in the osmotic pressures of the blood; and Th. Cohn advocates the introduction to clinical use of the freezing-point method for the determinations of alterations in the fluids of the body.

By investigations on 'The Influence of Alterations in the Kidney (either spontaneous nephritis or from cantharides) on the Course of Pancreas-Diabetes in Dogs' Ellinger and Seelig find that the elimination of sugar falls both absolutely and relatively to the nitrogen, but that this diminution in the glycosuria in no wise diminishes the hyperglycæmia, since it is accompanied by an increase in the sugar content of the blood. From experiments, also on dogs, 'On the Functional Capacity of the Heart in Fatty Degeneration' induced by 'Pulegon' (a substance like phosphorus in its effect on metabolism, but without direct influence on the heart) Lindemann finds the force and rhythm of the beat to remain long unaffected, and concludes that the abnormalities which ultimately result are due to the alterations in the cardiac muscle itself, and not to any influence on its nervous connections.

Four articles represent physiological chemistry. Salkowski contributes an analysis of the 'Hydrocephalus Fluid,' in which, like other observers, he finds an extremely small content of solids (100 cc. containing only 0.43 gram organic substances, mainly urea and dextrose, and 0.77 gram inorganic); Lowrow reports a study of the 'Decomposition Products of the Hæmoglobin of the Horse'; and Weiss the 'Separation of Methylpentose from White of Egg,' its presence or absence depending upon the food of the hen. In a study of the 'Glycocol Supply of the Animal Organism,' by R. Cohn, the methods used are essentially the same as those employed by Lusk in this country, and the results confirm the conclusions of the latter.

In one of the two papers devoted to bacteriology Hilbert is led by his experiments (on white mice) to answer the question, 'Are Toxic or Immunizing Substances Recognizable in the Filtrate of Streptococcus Bouillon Cultures?' in the negative. Finally, in perhaps the most valuable contribution in the volume Hans Meyer, on the basis of experiments performed by him in conjunction with J. T. Halsey and Fr. Ransom on 'Localized Tetanus,' shows that the toxin when injected into a nerve acts not only more quickly, but also more intensely, than when injected subcutaneously, since by the former method the spinal cord is reached more completely and in more concentrated form by the poison. It is further shown conclusively that the action of tetanus is entirely central, and that the greater part of the time of incubation is consumed in the slow passage of the poison to the central ganglia, and only a brief period in the performance of the chemical reaction in the cells affected. Finally, Meyer concludes that the neutralizing action of the antitoxin must occur outside the nervous system, since this substance never penetrates into either the peripheral or central ganglia, and

that the tetanus poison reaches the ganglia of the central nervous system, not by way of the circulation, but along the peripheral nerves.

YANDELL HENDERSON.

YALE UNIVERSITY.

SCIENTIFIC JOURNALS AND ARTICLES.

THE *Botanical Gazette* for November contains the following leading articles: G. T. Moore has published, with three plates, his second paper entitled 'New or Little Known Unicellular Algæ,' giving a detailed account of the life history of *Eremosphæra viridis*, and coming to the conclusion that for the present, at least, the genus should be classed with the Protococcoideæ; and also describing as a new genus a form which has been confused heretofore with *Eremosphæra*, and naming it *Excentrosphæra*. T. C. Frye has published, with one plate, an account of the development of the pollen in certain Asclepiadaceæ, his investigation having been suggested by the record that in certain members of this family there is no tetrad division. The development of the sporangium was found to be of the general type, the primary sporogenous cells passing over directly into pollen-mother cells; these latter divide in the usual tetrad manner, but subsequently through mutual adjustment the four spores are arranged in a linear series. Miss F. Grace Smith has published the results of a large number of observations upon the distribution of red color in vegetative parts in the New England flora. A general conclusion is reached that the statistical observations obtained fit no one theory of color in all particulars. Mr. George A. Shull has published, with illustrations, the results of observations upon 'Some Plant Abnormalities.' He records instances of fasciation in *Erigeron canadense* and *Echium vulgare;* abnormal foliage leaves in *Pelargonium* and *Hicoria*, and abnormal floral organs in *Lathyrus odoratus*, as well as in certain species of *Clematis*. Under the head of 'Briefer Articles,' E. B. Copeland has discussed Meissner's paper on evergreen needles, answering certain criticisms of the author, and presenting new observations; M. L. Fernald publishes a final paper upon the instability of the Rochester nomenclature, being an answer to papers of Messrs. C. L. Pollard, L. M. Underwood and N. L. Britton; and Charles Robertson has published a third set of observations of flower visits of oligotropic bees.

ANNOUNCEMENT has been received of the establishment of a new scientific journal entitled *Archivio Italiano di Anatomia e di Embriologia*, under the editorship of Professor Chiarugi, of Florence, already favorably known as the editor of the excellent little journal, the *Monitore Zoologico*. It is published with the cooperation of the professors of anatomy of Pisa, Padua, Sienna, Perugia, Ferrara, Genoa, Catania and Bologna. There has been a great awakening of anatomical and embryological study in Italy, but it has long been a matter of regret that although many important investigations have been published they have appeared in the proceedings of societies or in journals of very limited circulation, so that it has been very difficult for foreigners to secure access to this Italian work, much of which is extremely valuable. We shall, therefore, welcome a journal which will gather together and render more thoroughly accessible the results of anatomical and embryological research in Italy. The list of supporters of the new enterprise is a guarantee of its high character so that we may reasonably expect the new journal to rank as the equal of the best French and German journals. The subscription price for America is 31 francs, 50 centimes. The publisher is Luigi Niccolai, Via Faenza 44, Florence, Italy.

SOCIETIES AND ACADEMIES.

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 322d meeting was held November 19. Dr. Walter Hough occupied the session with an account of the explorations among the ancient pueblos of northeastern Arizona, carried on by him last season. The paper was illustrated with maps and selections of artifacts from the two thousand specimens secured during the work. The paper was discussed by F. W. Hodge, J. D. McGuire, Hon. H. M. Baker, Mrs. Matilda C. Stevenson, and President W. H. Holmes.

The 323d regular meeting was held December 3. Mr. S. P. Langley presented a paper on 'The Fire Walk of the Tahitans.' Mr. Langley

gave an interesting account of his voyage to the Society Islands. A number of lantern views of the scenery of Tahiti, the natives, their houses and their arts, were thrown on the screen, accompanied by instructive remarks. The incidents leading up to the ceremony of walking over the heated stones of the taro oven were detailed and a series of instantaneous views on the screen showed graphically the fire walk in progress. Mr. Langley dissipated the mystery that has enveloped this startling ceremony since it was first described. Briefly, his investigations show that the volcanic rocks employed are non-conductors, and though very hot on the under surface, are cool enough above to be walked upon with bare feet.

The paper was discussed by Mr. Townsend, W J McGee and Walter Hough. A vote of thanks of the Society was tendered to Mr. Langley for his valuable paper.

Dr. John E. Walsh, of the Peary Relief Expedition, read a paper, entitled, 'The Eskimo, their Country and Habits.' Dr. Walsh gave an account of the environment of the northern Eskimo as affecting their mode of life, their dwellings and arts. He found no evidences of social organization or religion among these Arctic Highlanders beyond certain minor customs. Dr. Walsh's paper was favorably received. In reference to the tattoo marks of the women spoken of by Dr. Walsh, W J McGee discussed the kinship of the Eskimo, adducing evidence that these marks were for the purpose of indicating relationship. Dr. D. S. Lamb and Dr. Frank Baker remarked upon the series of Eskimo skulls presented by Dr. Walsh. These skulls are notably scaphocephalic. Dr. Walsh also exhibited a number of ethnological specimens from his collection.

Walter Hough.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 541st regular meeting was held November 23, 1901. Dr. W. H. Dall spoke on 'The True Nature of Tamiosoma,' a fossil found in California in 1856 and described by Conrad. Its nature has been much discussed for nearly half a century and there has been great diversity of opinion as to its relationships. The speaker has recently acquired sufficient material to show that some former studies were based on broken specimens, and some on an inversion of the object. It is now clearly seen to be a barnacle.

Mr. J. F. Hayford discussed the question, 'What is the Center of an Area or the Center of a Population,' with especial reference to the general popular notion that the latter is the point which has as many people on one side of it as on the other. The difficulty with this definition is that the point varies according to the direction chosen; the only point that remains fixed, whatever fundamental directions are chosen, is that analogous to the center of gravity of an area; the sum of the squares of the distances from *this* center to all the elements of the area (or population) is a minimum. An ingeniously cut figure showed at a glance the absurdity of the popular idea. Mr. O. H. Tittmann read from an article written by Professor Hilgard in 1872 giving predictions on the movement of the center of population of the United States.

The 542d meeting was held December 7, 1901, Vice-President Gore in the chair.

Mr. Radelfinger presented a curious series that he had met with in differentiating a complex variable.

Professor T. J. J. See, of the Naval Observatory, presented the results of his recent measures of the diameters of the planets by daylight: the observations were made near the close of the day, when the sky was sufficiently lighted to prevent or at least to diminish the error from irradiation. Professor Campbell had made daylight measures on Mars in 1894, but all other published diameters are based on night work. The daylight observations are remarkably consistent, so that the speaker thought the results on Jupiter and Saturn might be relied on to 1 part in 1000. All the results are sensibly lower than former measures gave, *e. g.*, Jupiter, 38″.40 by night, 37″.65 by day; Neptune, 2″.25, and 2″.00, respectively. The densities of the planets as computed from these new values of the diameters are much increased. Similarly the diameters of Jupiter's satellites and Titan were measured. (The paper will appear in the *Astronomische Nachrichten.*)

Dr. A. F. A. King read a paper on the 'Etiology of Intermittent Fever,' in which he discussed *sunlight* as a factor in promoting sporulation of the malarial parasite, which he maintained would not take place in continued darkness. Hence 'chills' do not occur at night; races with non-translucent skins are immune; sunshine increases fever, cloudiness decreases it; spontaneous cures were explained by the shade of hospitals; the red light of the blood promoted the vital activity of the parasite, violet light restricted it, hence the cure by Prussian and methylene blues; quinine cured by its fluorescence accentuating the violet rays. (The paper will appear in the *American Journal of Medical Sciences.*)

CHARLES K. WEAD,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 344th meeting was held on Saturday evening, November 30.

William Palmer read some extracts from an illustrated article in one of the Sunday papers, on the alleged occurrence of toads in solid rock, and exhibited plaster molds from which some of the illustrations had been made. One of these molds, made over a dead frog, appeared in the picture labeled, 'a mold in which a frog lived for four days,' while the cast of a salamander was figured as 'a salamander emerging from a plaster mold in which it had remained for several days.'

E. W. Nelson presented a paper entitled 'A Naturalist in Yucatan,' describing the country and its flora, touching also on the ruins at Chichenitza, Uxmal and other points. The little known east coast was partly explored and Cozumel Island visited during Mr. Nelson's trip, and a number of colored lantern slides illustrated some of the most interesting features of plant and animal life observed.

H. J. Webber spoke of 'Strand Flora of Florida,' illustrating his remarks with many views of both the eastern and western coasts and describing the manner in which certain plants aided in forming sand dunes, and others such as the mangroves, in making small islets which later on were added to the mainland. The characteristic plants of various portions of the coast were noted, and the speaker drew attention to the marked difference shown by some plants, the grape nut for example, according as they grew inland or were exposed to the salt winds from the ocean. F. A. LUCAS.

THE AMERICAN CHEMICAL SOCIETY, NEW YORK SECTION.

AN unusual degree of interest has been manifested in the work of the Section during the present season. Very full programs have been offered at every meeting, and the attendance has been unprecedented. It has been necessary to hold a special meeting in order to dispose of the great number of available papers, and other special meetings will probably have to be held in the spring. The membership of the Section has increased steadily, and is now over four hundred and fifty. The committee to secure funds for the endowment of the research medal and for the encouragement of research among the members of the Section consists of Mr. Clifford Richardson, Professor C. F. Chandler, Mr. Maximilian Toch, Dr. Theron C. Stearns and Dr. William Jay Schieffelin. It shall be the endeavor of this committee to secure a large endowment fund and to suggest an appropriate name for the Section medal, as well as the detailed conditions governing its award. Since the last report of our meetings appeared in SCIENCE, the following papers have been presented:

Special Meeting, November 1.—Edmund H. Miller, 'On the Composition of the Ferrocyanides of Cadmium'; Marston Taylor Bogert and David C. Eccles, 'On the Production of the Imides of Succinic and Glutaric Acids by the Partial Hydration of the Corresponding Nitriles'; W. G. Lindsay, 'On a Colorimetric Method for the Estimation of Sulphur in Pig-iron;' Thomas F. Hildreth, 'On the Determination of Manganese in Spiegel'; John A. Mathews and William Campbell, 'The Alloys of Aluminium.' This paper was profusely illustrated by lantern photographs. It was presented in two parts. The first part being a review of recent work upon the constitution of alloys, with explanation of the nature of solid solutions, eutectics, pyrometric and metallographic methods of alloys, research, etc., the second part embodied the results of the re-

searches of the authors while in Professor Sir William Roberts-Austen's laboratory.

Regular Meeting, November 8. C. W. Volney, 'The Decomposition of Sodium Nitrate by Sulphuric Acid,' in which he showed that the reactions were much more complicated than has been generally supposed. Martin L. Griffin, of Mechanicsville, N. Y., 'The proximate analysis of the spent alkali liquor from the reduction of poplar wood for paper stock by the soda process, with a description of the method.' Mr. Griffin said that these liquors contain nearly 10 per cent. of acetic acid. The possible recovery of this great quantity of acid offers an interesting problem for chemists. Phoebus A. Levene's 'Preliminary Communication upon Gluco-Phosphoric Acid' was read by the secretary. William Campbell, of London, gave an illustrated talk upon his studies of the constitution of 'The Alloys of Copper and Tin.' Daniel D. Jackson, 'The Photometric Determination of Sulphates,' with exhibition of the apparatus. John A. Mathews, continuing his talk upon the constitution of alloys begun at the meeting of November 1, spoke upon 'Alloys and the Phase Rule.' This paper was illustrated with lantern diagrams and showed how the phase rule may be of use in explaining problems of equilibrium in such complex substances as alloys.

Regular Meeting, December 6. W. H. Birchmore presented an introductory paper, 'Notes and Studies on Molds and their Allies,' accompanied by an exhibit of many specimens. Professor Edgar F. Smith spoke on 'The Value of Electrolytic Methods in Chemical Analysis,' urging upon chemists their use or at least a fair trial of them. He contrasted the advantages of the electrolytic methods with the usual gravimetric methods. Professor Smith stated that twenty-five of the seventy elements could be conveniently determined in this way, and that more than one hundred and fifty separations were possible. Particular mention was made of the electrolytic determination of copper, mercury, bismuth, cadmium, molybdenum and uranium. He also mentioned a rapid electrolytic method for the oxidation of sulphur in natural sulphide minerals, by means of a current of ten or fifteen volts and one ampere. The sulphide is mixed with fused caustic potash in a nickel crucible which is made one of the electrodes, and a stout rod dipping into the fused caustic alkali is the other electrode. Fifteen minutes serves to oxidize completely the sulphur in pyrites, and most other natural sulphides require less time. Professor Wilder Bancroft read a paper upon 'Analytical Chemistry and the Phase Rule Classification.' Dr. Francis G. Benedict, in a paper upon 'Some Aspects of Ventilation,' gave experimental evidence to show that the high temperature and excessive humidity of expired air is a more potent factor in producing discomfort among those who have to breath it, as, for example, the inmates of a crowded and ill ventilated room or hall, than is the presence of a high percentage of carbonic acid. The experiments were made with human subjects in Professor Atwater's laboratory, and the results are interesting in that they are very much opposed to general ideas upon this subject and to the results which have been published by previous experimenters as well.

JOHN ALEXANDER MATHEWS,
Secretary.

THE NORTHEASTERN SECTION.

AT the last regular meeting of the Section held on November 19, 1901, the following officers were elected for the year 1901–1902: President, L. P. Kinnicutt; Vice-President, Charles R. Sanger; Treasurer, B. F. Davenport; Secretary, Henry Fay.

Professor A. A. Noyes addressed the Society on the 'Importance of Catalytic Agents in Chemical Processes.' The lecture was illustrated by numerous experiments, and was discussed under the following headings: (1) Catalytic Action in which the Catalyser Combines Temporarily with one of the Reacting Substances. (2) Catalytic Action by Absorbent Contact Agents. (3) Catalysis by Electrolytic Agents. (4) Water as a Catalyser. (5) Catalytic Action of Acids, Bases and Salts. (6) Catalysis by Enzymes. (7) Colloids.

At the next regular meeting to be held December 17, Professor C. F. Chandler will address the Section on 'Electro-Chemical Industries at Niagara Falls.' HENRY FAY,
Secretary.

THE LAS VEGAS SCIENCE CLUB.

THE usual monthly meeting was held November 12. Mr. Cockerell briefly reviewed the work of the members during the past summer. At the end of June the top of the Las Vegas Range (11,000 feet) was revisited, and a considerable collection was made, including a number of species of insects new to New Mexico. The insects of this collection are now being recorded in *Psyche*. Mr. Cockerell exhibited two stone spear-heads, which he found on the top of the Las Vegas Range. Seven members of the club spent a part of the summer on the coast of California, where special attention was paid to the Mollusca. Mrs. Cora W. Hewett exhibited a series of shells which she had collected at Coronado, Point Loma and La Jolla. Mr. Cockerell exhibited the internal shell of *Tethys* (*Neaplysia*) *ritteri*, a new species which he found at San Pedro, and named after the director of the University of California Marine Station at that place. This *T. ritteri* was about 21 cm. long, and differed from *T. Californica* in wholly lacking the bars of white and dark brown on the inner surface of the swimming lobes, these parts being of a pale seal green; it also differed in having oblique, flame-like, blood-red markings on the sides of the body. Outside of the Mollusca, some study was made of the insects of the California coast, and several new species of bees were obtained. Mrs. Cockerell found at San Pedro the hydroid *Aglaophenia octocarpa* Nutting, new to the United States.

Mrs. W. P. Cockerell described how she had succeeded in obtaining the eggs of *Argynnis nitocris nigrocærulea* at Beulah. The larvæ which hatched from them had gone into hibernation without feeding. A communication by Mr. Cockerell and Miss Mary Cooper on the genus *Ashmunella* was presented, and a series of the shells was exhibited. The most interesting was a new species, proposed to be called *Ashmunella antiqua*, found fossil in the Pleistocene beds of Las Vegas, N. M. It resembled in most respects *A. thomsoniana*, but wholly lacked the parietal tooth. Miss Ada Springer exhibited the vertebra of a bison which she had found in the charcoal zone of the Las Vegas (Arroyo Pecos) Pleistocene.

Mr. Emerson Atkins showed a series of drawings of the mouth-parts of wasps and bees. The series indicated an evolution from the type with six-jointed maxillary palpi and four-jointed labial palpi, the joints in each case about equal in length, to forms with five-, four-, three- or two-jointed maxillary palpi, and labial palpi with the joints much elongated and very unequal. It was remarked that the maxillæ increased in size, while their palpi diminished. Mr. John McNary communicated a series of drawings illustrating the venation of the middle of the tegmina in various genera of grasshoppers, viz., *Trimerotropis*, *Leprus*, *Arphia* and *Dissosteira*. It was possible to recognize the same veins as are found in the upper wings of Lepidoptera, but whereas in the Lepidoptera they are very constant and very useful for generic classification, in the grasshoppers, which are more primitive insects, they are found to be extraordinarily variable. If one were to depend on the venation for generic characters in Orthoptera to the same degree that one does in Lepidoptera, *Trimerotropis laticincta*, for example, could be split into three genera.

T. D. A. C.

THE TEXAS ACADEMY OF SCIENCE.

THE first regular meeting of the Texas Academy of Science for the present academic year was held in the chemical lecture room of the University of Texas, at Austin, on the evening of October 26, 1901, when Professor J. C. Nagle, of the Agricultural and Mechanical College of Texas, the newly elected president of the Academy, presented his inaugural address on 'The Influence of Applied Science.'

"My purpose," he said, "is to touch upon a few only of the general features of the world's progress, in which applied science has been an aid not only to material development, but to researches in pure science as well, and to suggest, if possible, some means by which the workers in applied science may be brought to contribute more largely towards advancing the purposes and aims of the Texas Academy of Science."

Continuing, the speaker said: "If the recorded history of the world's progress in thought and material prosperity for the last

two thousand years be roughly divided into two parts—the latter one dating practically from the beginning of the nineteenth century—and if the causes making for the amelioration of man's condition during these two periods be examined, we shall see that a single century of applied science has done more for the world's direct advancement in enlightenment, tolerance and real culture, as well as in material progress, than was accomplished in the preceding nineteen hundred years. Furthermore, a comparison of the opportunities and advantages possessed by man at the beginning, the middle and the end of the nineteenth century will show how much the rate of progress was accelerated during the latter half of the century, and if, judging by this, any prediction for the future may be ventured, we may gain some faint idea of the place applied science is destined to fill in the next fifty years."

Among the subjects dwelt upon somewhat in detail were astronomy, physics, especially electricity, civil engineering, chemistry and biology, with special reference to bacteriology. This address will appear in full in Part II. of Volume IV. of the *Transactions* of the Academy soon to be published.

The second meeting for the year was held on November 22. Mr. T. U. Taylor, professor of applied mathematics in the University, read an abstract of his report to the Hydrographic Division of the United States Geological Survey on the 'Water Power of Texas.' In this report he treats of the water power of the State, both existing and prospective, with special reference to that of the following rivers: Pecos, Devils, San Felipe, San Antonio, Guadalupe, Comal, San Marcos, Colorado and tributaries, Brazos and tributaries. The potential water powers at Llano and Marble Falls are considered in detail, and the latter is pronounced as having the grandest possibilities of any place in Texas. Llano and Marble Falls are in the heart of one of the finest granite regions of the country, and every unit of power could be made to pay in that industry alone.

A translation of a part of the introduction to Dr. Ferdinand Roemer's 'Kreidebildungen von Texas,' by Dr. Frederic W. Simonds and Edmund Wild, was read by the latter. 'Die Kreidebildungen von Texas' contains observations upon the geology of the State made fifty years ago. It is, in fact, the foundation of Texas geology, and won for its writer the title 'Father of the Geology of Texas.' This work has been a fruitful source of inspiration to later writers upon the geology of this region, and it is now the intention of Messrs. Simonds and Wild to make it accessible to all by means of a carefully prepared English translation.

The midwinter meeting of the Academy will be held simultaneously with that of the State Teachers' Association in Waco during the holiday recess.

Frederic W. Simonds,
Secretary.
University of Texas.

The Boston Society of Natural History.

At the meeting of the Society, held November 6, 1901, Professor William Morris Davis spoke on 'River Terraces in New England,' with a view to supporting a recent theory to account for the successive stair-like terraces with concave fronts found in many New England valleys. A buried ledge of gradual slope encountered by a meandering stream in its sidewise swingings, throws the stream to one side, and prevents its further cutting action at that point. When the stream, in subsequent swinging across the valley floor, returns once more to the attack, it encounters the ledge at a lower level, and is again turned back; thus the terraces as formed are protected from erosion.

At the meeting of November 20, 1901, Professor E. S. Morse presented the results of his researches on living Brachiopoda. He gave an account of the habits of *Lingula* and *Glottidia* and called attention to their marvelous vitality. He described in detail the structure of the leading forms and announced for the first time the œsophageal glands in *Lingula*. A correlation was shown between the presence or absence of setæ and the development of the pedicle; the errantian forms and those moving freely on the pedicle having the setæ greatly developed, those more restricted in their motion having shorter and fewer setæ, while those with lower valve fixed to the rock, such as *Mergerlia*, *Crania*, etc., are without setæ. In the young of all forms studied, the setæ were present, and of great

length. The cœcal tubes, which Dr. Sollas has shown to be probably organs of tactile impression, were wanting in the errantian forms, more or less abundant in those moving freely on a fixed pedicle, and in those fixed by the lower valve, abundant, and in *Crania* even branching. He described the external glands of *Terebratulina*, as well as the strand-like bundle of sperm cells. He insisted that the Heart of Hancock was not a pulsating organ, and was inclined to believe that the 'accessory hearts' were genital in their nature.

GLOVER M. ALLEN,
Secretary.

DISCUSSION AND CORRESPONDENCE.

CONNECTICUT RIVERS.

IN the issue of SCIENCE of November 29, 1901, Professor W. M. Davis reviews my paper on 'The River System of Connecticut' (*Journal of Geology*, IX., 1901, pp. 469–485) and expresses his doubt respecting the principal thesis of the paper; namely, that Connecticut rivers betray by their orientation a controlling influence of joint or fault planes. The subject of stream orientation is a large one and the explanation offered a somewhat new one for American rivers at least. The thesis is one not easily demonstrated as respects the larger area treated, and the review seems to me to be in the main an eminently fair one. From it I infer, however, that my paper may in some particulars be susceptible of misinterpretation, and, therefore, take this opportunity to correct certain impressions which appear in the review, so as, if possible, to prevent further misunderstanding.

If I have omitted to speak at length of the particular controls of stream orientation other than by joint and fault planes, it has not been because I would ascribe little importance to them, but because in a general paper dealing with a special kind of control it was obviously impossible to treat all at length. On page 474 it was stated:

"It is not to be expected that the actual course of a stream will now be coincident with or even absolutely parallel to any fault direction, for there have unquestionably been many local conditions which have produced larger or smaller migrations of the river channels. Their general direction has, however, it would seem, been maintained despite the minor accidents which have marked their life histories, and even under so revolutionary a change as complete reversal of drainage."

I should certainly agree with Professor Davis when he says that, "it is inherently improbable that the Pomperaug fault lines possess an extension all over the State in systems so rigid as are here postulated." And it was a matter of some surprise to me when the natural trough lines were found in so many instances to correspond to known fault directions of the Pomperaug Valley. Some explanation of this may, however, be found in the fact that the lines noted for the master streams of the State correspond in direction, not to the prevailing faults in the Pomperaug Valley, but rather to the exceptional ones. In the Shepaug Valley immediately adjacent to the Pomperaug, however, the only control observable is from the four directions of faulting which *prevail* in the Pomperaug Valley. It is my anticipation that when the theory is applied in detail to the broader area of the Connecticut Valley, and the directions of streams carefully compared with the directions of the actual *minor* as well as major faults of that Newark basin, a control will be recognized to have gone out from the planes of faulting. That the directions which were discovered in the Pomperaug Basin will be found to be the only ones I do not of course expect, and it is quite likely that in certain areas they may not appear at all. That an elaborate system of joints and faults, analogous to that of the Pomperaug Valley exists and is accountable for the zigzag outlines of the trap hills scattered over the Connecticut Valley seems to me, however, hardly to admit of doubt. That such a system ceases to exist beyond the border of the Newark is, in my view, inherently improbable.

I should be the last to wish to push the theory of control of streams by fault and joint planes beyond what the facts warrant. In the Pomperaug Valley itself the faults supposed to control the drainage were in the majority of instances discovered. In the near-lying area, *e. g.*, the Shepaug river basin, where the rivers adhere to the four prevailing fault directions of the Pomperaug Valley, this explanation seems

almost a necessity. As regards, however, the extension of the system throughout the State, where individual work in the field should be done in order to familiarize the worker with special and local conditions, I fully recognize the incompleteness of the evidence. It deserves to be emphasized, however, that the student of a carefully prepared map has always at hand the accumulated knowledge acquired by the corps of topographers whose painstaking labor it represents—labor which the modern school of physiographers has been quick to use as the basis of their conclusions. It is not assumed that along every trough line of the map lies the course of a fault. In my article it is stated (p. 478):

"The term 'trough lines' * * * may, for the present, be given no further signification than lines so favored by nature that the waters of the region have been induced to adopt them for their channels over longer or shorter distances. On a map of this scale the trough lines, if rectilinear, should be slightly curved, but inasmuch as the present river courses, because of the many accidents of their history, can only roughly approximate to the directions initially given them, it would be an over refinement to introduce a correction of this nature."

Evidence obtained from the examination of a map by this method can only be of value when cumulative. A single stream which persists in a given direction even for a long distance affords little support to the theory, when compared with that yielded by a number of smaller streams each approximating to a rectilinear course for a shorter distance, *provided the rectilinear courses are parallel.* A harder layer of rock, or a barrier of drift may conduct one stream or the other in its course, but it is inherently improbable that one of these causes or the other, or both combined, have controlled the parallel river series in an area of such geological structure as we find in the State of Connecticut. As was pointed out in the paper, it is worthy of note that so few of the master streams of the area follow the slope of the plain of erosion. As regards the larger area of the State the theory may, perhaps, as Professor Davis says, 'be regarded as standing in an interrogative rather than in a demonstrative attitude,' but it would be doing injustice to the facts to consider the trough lines as isolated lines while ignoring their arrangement in parallel series.

Wm. H. Hobbs.

PHYSIOLOGICAL EFFECT OF DIMINISHED AIR PRESSURE.

To the Editor of Science: The interesting communications of Messrs. Clayton and Ward upon the physiological effects of the diminished air pressure due to mountain climbing recall some records which I made in 1896 during an ascent of El Misti, Peru, similar to that described by Professor Ward. As the effect of the high altitude upon my condition was in part different from that experienced by him, it may be of interest to describe it. The journey from the observatory at Arequipa, elevation 8,050 feet, to the summit of El Misti, elevation 19,200 feet, was made on four occasions. The distance is about 25 miles. It is possible to ride on horseback or muleback to the very summit, following a caravan trail across the pampa to the base of the mountain, and ascending by a winding path constructed with great skill by Professor S. I. Bailey when the meteorological station was established. The journey from the observatory to a hut at an elevation of about 15,400 feet occupies one day, during which the rider is usually obliged to endure the scorching rays of the sun. The night is passed at the hut, and the final ascent to the summit made on the second morning. This occupies several hours, as the animal stops to rest every fifteen or twenty feet at this altitude. On two occasions I was obliged to walk a short distance to cross snow which had drifted across the path, and realized the extreme difficulty of breathing during the exertion required. The return from the summit to the observatory is easily made on the second day, but on two occasions I spent a second night at the hut.

The effect of the altitude upon me was chiefly to cause headache, sleeplessness and partial loss of appetite. On one occasion while at the summit I experienced a decided feeling of faintness for a short time. During the nights at the hut the temperature was about 32° Fahr., but it seemed impossible to keep the body warm, in

spite of arctic sleeping bag and blankets and overcoats so numerous that one could hardly lift the weight in breathing. On the trips in which a second night was passed at this height, more sleep was secured, indicating that the body was getting adjusted to the altitude. The headache disappeared and the appetite revived on the return trip. On the first of these trips, records were made of the pulse and respiration, as accurately as could be made by a person upon himself. They are as follows: Aug. 18, 10 p. m., at observatory on retiring, pulse 80, respiration 16; August 19, 6.00 a. m., on rising, pulse 80, respiration 16; 3.30 p. m. at tambo de los huesos, elevation 13,300 feet, pulse 96, respiration 12; Aug. 20, 6.25 a. m., at hut 15,400 feet, on rising, pulse 90, respiration 12; 12.30 p. m., at summit, 19,200 feet, pulse 86, respiration 11; Aug. 21, 10 a. m. at hut, 15,400 feet, pulse 86, respiration 11. The rather small increase in the pulse and the decrease in the respiration are noteworthy. While I made no records on other trips, I noticed frequently that my tendency was to breathe more slowly than usual, except when moving about.

WINSLOW UPTON.

PROVIDENCE, R. I.,
December 7, 1901.

SCIENTIFIC ORNITHOLOGY.

THE following remarkable misuse of terminology occurs in Mr. Robert Ridgway's 'Birds of North and Middle America,' Part I., The Finches, just from the press of the Government Printing Office. He says in his Introduction: "There are two essentially different kinds of ornithology: *systematic*, or *scientific*, and *popular*. The former deals with the structure and classification of birds, their synonymies and technical descriptions. The latter treats of their habits, songs, nesting, and other facts pertaining to their life-histories." And he continues: "Popular ornithology is the more entertaining with its savor of the wildwood, green fields, the riverside and seashore, bird songs and the many fascinating things connected with out-door nature. But systematic ornithology, being a component part of biology—the science of life—is the more instructive and therefore the more important." And are, indeed, life-habits and life-history not biology, not, if scientifically studied, science of life, not more important than the mere forms which result from this part of bird biology? Could there be found a worse misconception of where science and popular writing differentiate!

X.

SHORTER ARTICLES.

THE RESULTS ATTENDING THE EXPERIMENTS IN LOBSTER CULTURE MADE BY THE UNITED STATES COMMISSION OF FISH AND FISHERIES.

IN April, 1900, the United States Commission of Fish and Fisheries appropriated several thousand dollars to be used in devising, if possible, a practical method of artificial lobster culture, and the undersigned was appointed to take immediate charge of the experiments.

The breeding period of the lobster, continuing as it does only through a few weeks of the late spring and early summer, is so brief that extended experiments have been impossible, but the experiments that have thus far been made (during the spring of 1900 and of 1901) would indicate that very large numbers of lobsters may be hatched and retained in captivity until they have reached an age when they are well able to take care of themselves. Indeed, it would seem that the enormous mortality among lobster young (which results either from boiling females 'in berry,' or stripping the eggs from the female as the lobsters are taken from the traps) may not only be lessened, but that the young enclosed in these eggs may, with very little expense, be hatched in the more important fishing ports and hamlets and protected until they have passed through the critical stages.

It seems advisable to defer the rendering of the final report until the Commission has profited by the experiments of another season. Inasmuch, however, as the problem is of considerable economic importance, it would seem desirable to make some report at the present time, although only a report of progress.

In the spring of 1900 a number of experiment stations were established along the New England coast, namely, at Orrs Island, Freeport, Annisquam, Gloucester, Woods Holl, Naushon and Wickford. Experiments had been made previously at Woods Holl, but without encour-

aging results, and it was thought that the establishment of several stations might result in the discovery of some locality having physical and biological conditions more favorable than those found at the government laboratory. The officers of the stations at Gloucester and Woods Holl and the officers of the *Grampus*, *Fish Hawk* and *Phalarope* cordially cooperated in the work of the special committee, but the experiments at all the stations excepting that at Wickford were discouraging. The lobster fry, even in the cold clear water of the Gulf of Maine, would soon become covered with a chenille-like growth of diatoms and would die, no matter what kind of enclosures were used.

At Wickford, however, where the Rhode Island Commission had courteously given the use of their floating house-boat, the fry seemed to find a more congenial environment. In what respects the water and the plankton at Wickford were more favorable to the fry cannot at the present time be stated; it was, nevertheless, a fact that the young taken from the hatchery at Woods Holl would quickly perish when confined at various localities near Woods Holl, but would thrive when placed in the same kind of enclosures at Wickford. The water at Wickford is rather fresh and of high temperature (often ten degrees higher than at Woods Holl). It is charged with vegetable and animal life, and the current is sufficiently strong to assist materially in the aeration of the water in the enclosures.

Many different devices for enclosures were adopted and tried. Large salt-water ponds, smaller pools, artificial pools made by the building of dikes, enclosures made of wire screen and floated and wire screen and submerged, huge canvas boxes and cars, cars of scrim floated and anchored at the bottom, glass jars of various sizes, running water in vessels of wood, metal, glass, porcelain and stone, and various rotary devices, all proved efficient agents for the killing rather than for the rearing of lobster fry.

The only enclosures which gave encouraging results were made out of scrim in the shape of huge bags some sixteen feet in diameter and several feet in depth and so leaded at the bottom that they would rise and fall with the current and agitate the enclosed fry. But the current was not sufficient at all times to keep the young lobsters from settling to the bottom, devouring one another and gathering into a confused mass of maimed and struggling individuals. At these times it was necessary for the staff at Wickford to agitate the water artificially, and this was done by the use of paddles.

To Dr. A. D. Mead, who was the director of the Wickford laboratory, is due the credit of having demonstrated the importance of keeping the young lobsters from the bottom of the enclosure, by either natural or artificial means.

Under favorable conditions the growth of the young fry is phenomenal. The first molt takes place about six days after the young have left the egg, the second molt some six days later and the third about five days later still. The third molt takes the fry into the fourth stage, when they assume the characters and habits of the adult. Under the most favorable conditions this fourth stage may be reached in nine days from the time the lobsters are taken from the hatching-jars, but under less favorable conditions, within the same enclosures, certain individuals may be found in the second stage after a lapse of several weeks. In both structure and habits the young that have reached the fourth or 'lobsterling' stage are very different from those of the previous stage. These older individuals (known at the laboratory as 'fourses') are provided with pinching-claws, hardened shell and vigorous muscles. They are very active, have a voracious appetite, and are pugnacious and secretive.

It is well known that the planting of a few young trout in the fingerling stage will accomplish much more toward restocking our streams than the planting of many thousand fry, and I think it safe to conclude that the planting of many thousands of lobsters in the 'lobsterling' stage would do much more toward rehabilitating the waning lobster industry than the planting of many millions of helpless fry as they leave the hatchery.

No special effort was made in 1900 to treat the fry after they had reached the fourth stage, but a few were retained. Those of the United States Fish Commission office at Washington have been obliged to endure the more artificial environment of an aquarium. Those at Wick-

ford have had a somewhat more natural environment, having spent the winter in a submerged crate. They are hardy, voracious and seem to thrive.

The plans for the second year were based on the successes and failures of the first, and it was thought best to take advantage of the favorable environmental conditions at Wickford, to discontinue the work elsewhere, and to put all the energy into devising some economical contrivance for keeping the water so agitated that the fry would not and could not settle to the bottom.

After many experiments, a relatively simple and inexpensive device was adopted. Several bags of scrim about three feet in diameter and four in depth were so suspended in the pool of the floating laboratory that the current could not change their general shape or cause them to collapse. In each bag was placed a dasher, the blades of which in rotation would constantly lift the water through the mesh at the bottom of the bag and urge it with obviously less velocity through the pores of the vertical walls. The dashers were kept in motion by means of a small gasolene engine, the motor apparatus as a whole having a striking resemblance to the aerating equipment of a second-class restaurant. The scrim bags looked like so many vertical cylinders. We found that when the mechanism was in actual operation the current in rising through the bottom of the bag brought with it large numbers of pelagic animals, while the reduced current of the water passing through the greater expanse of the vertical walls was not sufficient to carry this living material out of the bags; thus the apparatus sufficed not only for keeping the fry and artificial food from the bottom, but it also provided the fry with living natural food. To Mr. George H. Sherwood is due the credit of devising and installing this aerating and feed apparatus.

In practice it was found that the eggs stripped from the abdomen of the female would hatch in these scrim enclosures under much more favorable conditions than in McDonald jars. Indeed, I am inclined to believe that a far higher percentage of eggs would hatch in these bags than in the McDonald jars, and I am sure that the young are in a much more healthy condition than when hatched by the older method. Even a superficial examination of the young that have spent some hours in the trituration of the McDonald jars will show that a large proportion of them have the appendages broken, bent or indented.

The number of fry that were available for the purpose of experimentation during the first season was considerably less than in 1900, and the period of experimental work was also materially reduced. Nevertheless, Dr. Mead, who had the work immediately in charge, reports that by actual count in no case was the number of lobsters that reached the fourth stage less than 16 per cent. of the number of fry originally placed in the enclosure. In a few cases it was above 40 per cent. and in at least one case it was as high as 54 per cent. In previous years no experiments had yielded more than a fraction of one per cent. The total number of lobsters raised to the fourth stage during the season of 1901 (in the twelve cylinders) was a little more than nine thousand.

Encouraged by these results, the United States Commission of Fish and Fisheries is now planning to equip one or more stations with the aerating, hatching and brooding apparatus above described, and to actually test the feasibility of raising large numbers of fry to the fourth stage, and I feel convinced that the liberation of large numbers of these more hardy young will result in the restocking of our depleted waters.

H. C. BUMPUS.
AMERICAN MUSEUM OF NATURAL HISTORY.

ON THE STRUCTURE OF THE MANUS IN BRONTOSAURUS.

During the past season, while engaged in collecting vertebrate fossils for the Carnegie Museum, Mr. Charles W. Gilmore had the good fortune to discover in the Jurassic exposures on Sheep Creek, in Albany Co., Wyo., a very considerable portion of the skeleton of *Brontosaurus*.

This skeleton was very carefully taken up by Mr. Gilmore and has been received at the museum. Among the more important parts secured was a nearly complete fore limb and foot with the different elements for the most part still retained in their normal position, making it possible for the first time to definitely deter-

mine most of the more important points regarding the structure of the manus in this genus of the Sauropoda.

The entire limb and foot were taken up in two sections, in one of which was the humerus, while the other contained the radius, ulna, and such portions of the manus as were preserved, consisting of the supposed scapholunar, the complete series of metacarpals, the five proximal phalanges, and the ungual of the first digit. All these elements when found, except the scapholunar, lay in approximately their normal positions, with reference to each other, and thanks to the skill and care of Mr. Gilmore, they were so taken up and packed that their original positions had not been disturbed when the limb and foot were unpacked in the laboratory.

The radius, ulna and manus have already been partially freed from the matrix by Mr. Gilmore, and throw considerable light upon the structure of the latter.

The limb when found lay with the palmar side up. The proximal end of the radius lay in the radial groove on the anterior surface of the ulna, these bones still articulating with the distal end of the humerus. Lying between and upon the palmar side, near the distal end of the radius and ulna, was a large flat bone presenting on one side a gentle but regularly convex surface, and on the other two flat, subequal surfaces separated by a low ridge. This bone I have interpreted as the scapholunar, and it seems to be the only carpal element retained in the Brontosaur manus.

Metacarpals I., II., III., IV., V. were in regular order at the distal extremity of the radius and ulna, though the first and fifth were closely applied to the external lateral surfaces of the distal ends of the radius and ulna, indicating that in life they articulated directly with these bones, perhaps through the intermedium of heavy cartilaginous pads, while the three median metacarpals were a little more removed in order to accommodate the scapholunar mentioned above.

The proximal phalanges of all the digits were present and nearly in their normal positions with relation to their respective metacarpals. That of digit I. was in contact with its metacarpal, but shifted from its normal position so that its external lateral surface was opposed to the distal end of the metacarpal, with its proximal articular surface turned inward toward the median axis of the foot, and the distal outward. The proximal phalanx of digit II. was in position at the extremity of metacarpal II., but very much flexed, so that its longitudinal axis lay almost at right angles to that of metacarpal II. It is much the larger and stronger of the series of proximal phalanges, and has the distal articular surface deeply grooved for the keel of the second phalanx. The first phalanx of digit III. is much smaller than that of the second, and presents distally a small, but well-formed and slightly grooved, surface for the articulation of the succeeding phalanx. It (the first) was found in its proper position at the extremity of metacarpal III., and there was on the palmar side, interposed between it and that bone, a small rounded sesamoid. The proximal phalanx of the fourth digit was in position articulated with metacarpal IV. It is the smallest of the series and presents distally an ill-defined articular surface. That of digit V. lay at the extremity of its metacarpal, but with its external lateral surface opposed to the distal end of the latter. This phalanx is slightly larger than the corresponding one of digit IV., but its distal extremity scarcely shows any trace of an articular surface for a succeeding phalanx. These were the only phalanges found with this foot except the ungual of the first digit, which lay in its normal position with reference to that of the first phalanx as the latter has been described above, except that it was turned on its side and had been moved slightly backward, and lay with its articular surface abutting against the external border of the distal articular surface of the first phalanx and the external lateral surface of metacarpal I.

There was a slight vertical displacement in the carpal region, so that the distal ends of the radius and ulna were a little lower than the metacarpals. Metacarpals I. and V. lay in such position with reference to II., III. and IV. as to indicate that the proximal ends of these bones were arranged in the arc of a circle, and not horizontally.

From the above brief description it will readily appear that the Sauropod manus in *Brontosaurus* at least was like the pes, arranged on the entaxomic plan, and not mesaxomic as Professor Osborn was led to believe from a study of the abundant but isolated material in the collections of the American Museum of Natural History.

This foot and limb will be more fully described and adequately illustrated in the coming number of the *Annals* of this Museum.

J. B. HATCHER.

CARNEGIE MUSEUM,
December 2, 1901.

GOLDFISH AS DESTROYERS OF MOSQUITO LARVÆ.

IN Professor L. O. Howard's recent excellent volume on 'Mosquitoes,' etc. (p. 161), reference is made to a reported employment of 'carp' as destroyers of mosquito larvæ and doubt is expressed as to the facts in the following words:

"It was stated a number of years ago in *Insect Life*, that mosquitoes were at one time very abundant on the Riviera in South Europe, and that one of the English residents found that they breed abundantly in the water tanks, and introduced carp into the tanks for the purpose of destroying the larvæ. It is said that this was done with success, but the well-known food-habits of the carp seem to indicate that there is something wrong with the story. If top-minnows or sticklebacks had been introduced, however, the story would have been perfectly credible, and it points to the practical use of fish under many conditions."

An examination of *Insect Life* (Vol. IV., p. 223) and also of *Nature* (Vol. XLIV., 1891, p. 591)—the original source of the statement in question—fails to reveal the precise species of 'carp' here referred to, but if, as seems likely, it was the common goldfish, *Carassius auratus*, I happen to be in a position to confirm the general truth of the story.

About six years ago at my home in Belmont, near Boston, Massachusetts, I constructed a small artificial pond in which to grow water-lilies and other aquatic plants, and also to breed, if possible, some varieties of goldfish—though the latter object was a secondary consideration. The advisability of making this pond had been somewhat questioned on account of its close proximity to my house and the fact that such ponds are likely to become excellent places for the propagation of mosquitoes. Nevertheless, the plan was carried out and the pond was stocked with goldfish taken from natural ponds in the vicinity where they had been living and breeding, to my personal knowledge, for a number of years.

The aquatic garden has proved a success and the goldfish have meantime thriven and multiplied. Moreover, no mosquitoes attributable to the pond have appeared and I have been unable to find any larvæ in it, although I have searched repeatedly and diligently for them. I have always believed that the absence of mosquito larvæ from this pond was due to the presence of the goldfish, and I have so stated in a paper 'On the Drainage, Reclamation and Sanitary Improvement of Certain Marsh Lands in the Vicinity of Boston' in the *Technology Quarterly*, XIV., 69 (March, 1901), as follows: "In the water [of this pond] are hundreds of goldfish that feed upon the larvæ of mosquitoes and serve to keep this insect pest in check."

On observing the statement referred to in Professor Howard's book I determined to make careful observations, to settle the point in dispute. Within fifty feet of the pond in question stands a large tank which for a long time last summer was filled with rain water. Here I found constantly large numbers of mosquito larvæ, of both *Culex* and *Anopheles*. Between this tank and the pond runs a cool brook, fed by a spring. Here also I found abundant mosquito larvæ, those of *Anopheles* being more prevalent than those of *Culex*. Reflecting upon this fact it seemed more probable than ever that the goldfish were holding the mosquitoes in check in the artificial pond while in the brook the insects were breeding in comparative safety.

To test the correctness of my theories I took from the pond a small goldfish about three inches long and placed it in an aquarium where it could, if it would, feed upon mosquito larvæ and still be under careful observation. The result was as I had anticipated. On the first day, owing perhaps to the change of environment,

and to being rather easily disturbed in its new quarters, this goldfish ate eleven larvæ only, in three hours; but the next day twenty were devoured in one hour; and as the fish became more at home the 'wigglers' disappeared in short order whenever they were dropped into the water. On one occasion twenty were eaten in one minute, and forty-eight within five minutes. This experiment was frequently repeated, and to see if this partiality for insect food was a characteristic of those goldfish only which were indigenous to this locality, I experimented with some said to have been reared in carp-ponds near Baltimore, Maryland. The result was the same, though the appetite for mosquitoes was even more marked with the Baltimore fish than with the others. This was probably due to the fact that they had been in an aquarium for a long time before I secured them, and had been deprived of this natural food. I also tried the experiment of feeding commercially prepared 'goldfish food' and mosquito larvæ at the same time, and found that in such a case the goldfish invariably preferred the larvæ.

It is not as generally realized as it should be that goldfish will thrive in our natural northern waters. In my experience they can easily be bred in any sheltered pond where the water is warm and not fed by too many cold springs, and form any years they have been breeding naturally in many small ponds in the vicinity of Cambridge, Massachusetts.

When it is once understood that these fish are useful as well as ornamental and comparatively hardy, it is to be hoped that they will be introduced into many small bodies of water where mosquitoes are likely to breed, and thus be employed as a remedy for mosquitoes sometimes preferable to kerosene.

William Lyman Underwood.
Massachusetts Institute of Technology, November 27, 1901.

NOTES ON INORGANIC CHEMISTRY.

NEW WORK ON RADIUM.

A new series of experiments has been carried out by Berthelot on radium, with reference to its chemical action, as shown upon several compounds. The radium used was enclosed in one sealed glass tube within another, and in some of the experiments within a third, so that its influence was much weakened and some of the active rays were altogether cut off. The action took place in the dark and was exceedingly slow. Iodin pentoxid was decomposed by the radium rays just as by light, and the same was true of nitric acid. Since both of these reactions are endothermic, the rays must furnish chemical energy. The change of rhombic sulfur into the insoluble variety, an exothermic reaction which is effected by light, was not affected by the radium rays. The rays have no influence upon acetylene, which is very sensitive to the action of the electric current but is unaffected by light. Oxalic acid also was not changed, though it is readily oxidized even in diffused light. The glass tubes in which the radium was contained were blackened, owing probably to a reduction of the lead. A purple color was also noticed in the glass near the blackened portions, which was attributed to an oxidation of the manganese present.

In this connection it may be noted that the existence of the radio-active lead, recently described by Hofmann and Strauss, is denied by Giesel. He considers it to be a mixture of lead with a little radium. He confirms, however, the observation of several workers, that water can be rendered strongly radio-active by radium. He enclosed half a gram of radium-barium bromid in one arm of a sealed U-tube, distilled the water of crystallization over into the other arm, and then sealed it off by fusion. Both the water and the air in the sealed tube were strongly active, more so indeed than the original salt. That this was not due to minute particles of radium which had been driven over mechanically was proved by the fact that the radio-activity disappeared within a few days.

AMMONIA ON METALS.

In endeavoring some years since to find a metal which would withstand the action of ammonia gas at high temperatures, G. T. Beilby noted the fact that every metal tested soon become brittle and spongy. In conjunction with G. G. Henderson, Mr. Beilby has now investigated the phenomenon more closely and the results are published in the last number of the *Journal of the Chemical Society* (London). It has

long been known that ammonia is rapidly decomposed into nitrogen and hydrogen by the action of red-hot iron, but the effect upon the iron has attracted less attention. The authors find that whatever the metal used, it becomes changed in its appearance and very brittle. With some metals, as iron, the action is very rapid, with others slower, but even gold and platinum cannot resist this action of ammonia. Under the microscope the metal gives evidence of having been fused or semi-fused, and of bubbles of gas having escaped through the fused metal. The authors conclude that under the influence of the ammonia a nitrid of the metal has been formed, which is stable only within narrow limits of temperature, and which is fusible at the temperature of its formation. At slightly higher temperatures than that of its formation, it is decomposed into the metal and the escaping nitrogen gives the peculiar appearance to the metal. Pure iron was found to be rendered hard and brittle by the absorption of small quantities of nitrogen and a rod of charcoal iron was made so hard that it could be used as a drill. The thought naturally suggests itself that the presence of nitrogen may play some part in the manufacture of cement steel. The results of this investigation make it clear that there is no metal of which pipes can be made for the conveyance of ammonia at high temperatures, and that porcelain is the only available material for this purpose.

FITTICA'S LATEST TRANSMUTATION.

PROFESSOR FITTICA has been heard from again, and this time he claims to convert boron into silicon, or rather he considers boron to be an oxid of silicon, contaminated perhaps with carbon. By heating boron in a silver dish with sodium or potassium or their hydroxids, he obtains a dark, oily mass, from which carbon can be isolated by acidifying. The chief constituent of this mass, however, is silicic acid, as shown by familiar tests. The alkali was proved to be originally free from silicic acid, but no evidence is presented that the boron used did not contain silicon. Other methods for effecting this conversion were successful, but all seem to be open to the same criticism.

J. L. H.

CIRCULAR OF INFORMATION OF THE NATIONAL BUREAU OF STANDARDS, NO. 1.

ANNOUNCEMENT OF ORGANIZATION.

BY an act of Congress approved March 3, 1901, the Office of Standard Weights and Measures of the Treasury Department was, on July 1, 1901, superseded by the National Bureau of Standards, the functions of which are as follows: The custody of the standards; the comparison of the standards used in scientific investigations, engineering, manufacturing, commerce, and educational institutions with the standards adopted or recognized by the Government; the construction, when necessary, of standards, their multiples and subdivisions; the testing and calibration of standard measuring apparatus; the solution of problems which arise in connection with standards; the determination of physical constants and the properties of materials, when such data are of great importance to scientific or manufacturing interests and are not to be obtained of sufficient accuracy elsewhere.

The Bureau is authorized to exercise its functions for the Government of the United States, for any State or municipal government in the United States, or for any scientific society, educational institution, firm, corporation, or individual within the United States engaged in manufacturing or other pursuit requiring the use of standards or standard measuring instruments.

For all comparisons, calibrations, tests, or investigations, except those performed for the Government of the United States or State governments, a reasonable fee will be charged. Provision is also made for the purchase of a site and the erection of a suitable laboratory, its equipment with the most improved facilities and the personnel necessary for the organization of the Bureau.

A suitable site has been selected in Washington in a locality free from mechanical and electrical disturbances, and yet easy of access. Plans are being prepared for a physical laboratory which will be equipped with apparatus and conveniences for carrying on investigations, and for testing standards and measuring instruments of all kinds. Also a somewhat similar building, to be known as a mechanical labora-

tory, which will contain the power and general electrical machinery, the instrument shop, refrigerating plant, storage batteries, dynamos for experimental purposes, and laboratories for electrical measurements requiring heavy currents.

The construction of the buildings will be pushed as rapidly as possible, and it is expected that they will be ready for occupancy by January 1, 1903. For the present, additional quarters have been secured in the building occupied by the former Office of Standard Weights and Measures, with a view to the organization of the bureau and the immediate development of the more needed extensions of the work heretofore carried on, such as photometric measurements, the testing of instruments for determining high or low temperatures, clinical thermometers, chemical glass measuring apparatus, electrical apparatus used to measure alternating currents, pressure gauges, and meteorological instruments.

For the present, however, the work of the bureau will be limited to the comparison of the following standards and measuring instruments, either for commercial or scientific purposes:

Length Measures.—Standard bars from 1 to 10 feet, or from 1 decimeter to 5 meters; base bars; bench standards; leveling rods; graduated scales; engineers' and surveyors' metal tapes 1 to 300 feet or from 1 to 100 meters.

Weights.—From 0.01 grain to 50 pounds, or from 0.1 milligram to 20 kilograms.

Capacity Measures.—From 1 fluid ounce to 5 gallons, or from 1 milliliter to 10 liters.

Thermometers.—Between 32° and 120° Fahrenheit, or 0° to 50° centigrade.

Polariscopic Apparatus.—Scales of polariscopes, quartz control plates, and other accessory apparatus.

Hydrometers.—Alcoholometers, salinometers and saccharometers whose scales correspond to densities between 0.85 and 1.20.

Resistances.—Coils of the following denominations: 1, 2, 5, 10, 100, 1,000, 10,000, 100,000 ohms; low resistance standards for current measurements of the following denominations: 0.1, 0.01, 0.001, 0.0001 ohm. Coils of resistance boxes; potentiometers; ratio coils.

Standards of Electromotive Force.—Clark and other standard cells.

Direct Current-Measuring Apparatus.—Millivoltmeters and voltmeters up to 150 volts; ammeters up to 50 amperes.

It is the desire of the Bureau to cooperate with manufacturers, scientists, and others, in bringing about more satisfactory conditions relative to weights and measures in the broader meaning of the term, and to place at the disposal of those interested such information relative to these subjects as may be in possession of the Bureau.

S. W. Stratton,
Director.

Washington, D. C.

MEETINGS OF SCIENTIFIC SOCIETIES AND CONVOCATION WEEK.

We call special attention to the calendar of the meetings of scientific societies which begin shortly after the issue of the present number of Science. They are as follows:

The American Association for the Advancement of Science. A meeting of the council will be held at the Quadrangle Club, University of Chicago, on the afternoon of January 1. Section H (Anthropology) will meet in the Field Columbian Museum, Chicago (December 31 and January 1 and 2). The next regular meeting of the Association will be held at Pittsburg, Pa. (June 28 to July 3). A winter meeting is planned to be held at Washington during the convocation week of 1902-3.

The American Society of Naturalists will hold its annual meeting at the University of Chicago (December 31 and January 1). In conjunction with it will meet the Naturalists of the Central States and several affiliated societies, including the American Morphological Society (beginning on January 1); The American Physiological Society (December 30 and 31); The American Psychological Association and the Western Philosophical Association (December 31 and January 1 and 2); The Society of American Bacteriologists (December 31 and January 1), and The American Association of Anatomists (December 31 and January 1 and 2).

The Astronomical and Astrophysical Society of America will meet in Washington (beginning on December 30).

The Geological Society of America will meet at Rochester, N. Y. (December 31 and January 1 and 2).

The American Chemical Society will meet at the University of Pennsylvania, Philadelphia (December 30 and 31).

The Society for Plant Morphology and Physiology meets at Columbia University, New York City (December 31 and January 1 and 2).

The American Mathematical Society and the American Physical Society meet at Columbia University, New York City (December 27 and 28).

SCIENTIFIC NOTES AND NEWS.

DR. ADOLF MEYER has been selected as director of the Pathological Institute of the New York State Hospitals. Dr. Meyer is at present director of the clinical work and laboratory of the Worcester Insane Asylum and docent in psychiatry in Clark University.

THE Paris Academy of Sciences has filled the vacancy in the section of physics, caused by the death of Dr. Raoult, by the election of M. Gouy, of Lyons, to corresponding membership.

LORD AVEBURY has been elected a foreign member of the Swedish Academy of Sciences.

PRESIDENT REMSEN, of the Johns Hopkins University, was entertained by the alumni in Boston on December 16. Speeches were made by President Remsen, President G. Stamley Hall, of Clark University, Professor A. L. Kimball, of Amherst College, Professor L. P. Kinnicut, of the Worcester Polytechnic Institute, Professor W. T. Sedgwick, of the Massachusetts Institute of Technology, and others.

PRESIDENT ELIOT, of Harvard University, has planned a trip to the Pacific Coast and the South, during which he will make many addresses. He will leave Cambridge about February 20, and will return the latter part of April.

PRESIDENT HARPER, of the University of Chicago, has declined the directorship of the International Congress at the St. Louis Exposition.

PROFESSOR W. W. ROWLEE, of the botanical department of Cornell University, and Professor J. C. Gifford, of the College of Forestry, have gone on an expedition to Cuba to study the forests and botany of western Cuba and the Isle of Pines.

PROFESSOR JOHN MACFARLANE and a party of students from the University of Pennsylvania are spending the Christmas holidays in botanical field work in Florida.

M. IZARE WEILLAR has come to the United States commissioned to study the organization of our technical schools and business methods.

DR. L. O. HOWARD, chief of the Division of Entomology, Department of Agriculture, lectured before the Biological Club of the Woman's College of Baltimore last week, on 'Mosquitoes and their Relation to Disease.'

PROFESSOR F. W. CRAGIN has recently obtained a new Colorado meteorite. It is from the eastern part of the State, and, like the three or four others hitherto found in Colorado, is an iron; the date of the fall is unknown. It is of square-lenticular form, strongly pitted, and weighs forty-two pounds.

DR. SVEN ANDERS HEDIN, the Swedish traveler, who has been exploring in the Gobi Desert and Thibet, has reached Ladakh, Kashmir, on his way home.

BARON TOLL says that his winter quarters have been established on the Nerpenskaye coast, in the neighborhood of the Lena Delta, and that an observation station has been opened at Kotelnys Island. During the summer the expedition reached latitude 77 degrees 32 minutes, in New Siberia.

THE memorial to Robert Fulton in Trinity Churchyard, New York City, to which we have already referred, was unveiled on the occasion of the recent meeting of the American Society of Mechanical Engineers.

A BUST of Alphonse Milne-Edwards has been completed by the sculptor Marqueste and will be placed in the Hall of Zoology in the Paris Museum of Natural History.

AT the anniversary meeting of the Royal Society, held on November 30, attention was called to the deaths of the following fellows and foreign members. The deceased fellows were Sir John Conroy, died December 15, 1900, aged 55; Lord Armstrong, died December 27, 1900, aged 91; Dr. William Pole, died December 30, 1900, aged 86; Professor George Francis Fitzgerald, died February 22, 1901,

aged 50; Dr. George Mercer Dawson, died March 2, aged 52; John Christian Malet, died April 9, aged 53; Professor Henry G. Hennessy, died March 8, aged 76; Professor John Viriamu Jones, died June 2, aged 45; Dr. Charles Meldrum, died August 28, aged 80. The foreign members were Charles Hermite, died January 14, 1901, aged 78; Henry A. Rowland, died April 16, aged 53; Henri de Lacaze-Duthiers, died July 21, aged 81; Professor Alexsandr Kowalewski, died November 22.

Professor Henry Fulton, dean of the School of Applied Science of the University of Colorado at Boulder, died on December 7, aged 55 years. Dean Fulton was prominent in educational affairs of the State for many years. By his death the University loses an able professor and valued administrative officer.

Professor Aleksandr Aleksandrovic Kovalevskij, professor emeritus of zoology at the University of St. Petersburg, died in that city on November 22.

Dr. Arthur König, associate professor of the physiology of the sense organs at the University of Berlin, and director of the physical section of the Physiological Laboratory, died on October 26 at the age of forty-five years. Dr. König was an assistant of Helmholtz's and aided in the preparation of the second edition of the *Physiologische Optik*. He had carried out important researches on vision, and, with Professor Herm. Ebbinghaus, edited the *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*.

The death is announced of Dr. A. A. Tokasky, head of the Moscow Physiological Laboratory.

Jacob Heinrich Krelage, a Dutch botanist and horticulturist, died on December 1, at the age of seventy-six years. He was head of a well-known firm engaged in the growing of bulbs.

Representative Woods, of California, has introduced a bill in the House creating a department of mines and mining. The department would have a secretary with a seat in the cabinet.

The recent changes in ownership and plans of the *Botanisches Centralblatt* have already been referred to in these columns. The Committee of the Society for Plant Morphology and Physiology, to which the selection of American editors for that journal was entrusted by the officers of the International Association, will make a full report to the Society at its Columbia meeting on December 31, and the substance of the report will also be announced to the botanists at the Chicago meeting. In the meantime we are authorized to announce the names of the American editors already chosen, who, with their respective departments, are as follows:

Phanerogams (systematic), and Chairman of the American Board, Professor William Trelease, Missouri Botanical Garden.

Morphology, Professor D. H. Campbell, Leland Stanford University.

Physiology, Professor D. T. MacDougal, New York Botanical Garden.

Cytology, Dr. C. J. Chamberlain, University of Chicago.

Paleontology, Professor D. P. Penhallow, McGill University.

Fungi, and Secretary of the American Board, Dr. Hermann von Schrenk, Shaw School of Botany.

Algæ and Archegoniatæ, Dr. G. H. Moore, of Washington, D. C.

Further announcements as to the organization of this board, etc., will later be made, but in the meantime it is desirable that the authors of all papers published in America should send separates directly to the respective editors. It is expected also that at the Columbia meeting nominations of the two members of the General Committee, to be voted for by the American members of the International Association, will be suggested.

The sixth annual meeting of the New York State Teachers' Science Association will be held at Syracuse, N. Y., on September 27 and 28. A full and carefully selected program is offered including papers and discussions interesting to all teachers of science.

Senator Wm. A. Clark has made a donation of $250 to facilitate the work of the University of Montana Biological Station at Flathead Lake. This is the fourth contribution from Senator Clark for this purpose.

One of the American delegates to the Pan-American conference in Mexico City has presented a plan looking to the creation of an inter-

national sanitary commission to be composed of not more than five members of each government, this commission to hold annual or periodical meetings, probably at Washington. At its meetings it would discuss and make recommendations on sanitary matters in general, particularly on the condition of dangerous or infected ports and other places, and the means of improving them.

THE Bibliographical Society of Chicago, an organization founded 'to encourage and promote bibliographical study and research,' has requested the Committee on Education of the St. Louis Exposition to appoint a Commissioner of Bibliography for the Louisiana Purchase Exposition whose duties shall be: (1) To have supervision and final control of all bibliographical publications that may be issued in connection with the Exposition, and to undertake, for his own part, the editing of a series of bibliographies of subjects relating to the Louisiana purchase, and the political, industrial and intellectual development of the territory concerned, and other subjects that may prove pertinent. (2) To collect a complete set of all printed matter relating to the Exposition and to compile an accurate catalogue thereof, and (3) to arrange for an international bibliographical exhibit, with the idea of keeping the same intact after the close of the Exposition as a permanent bibliographical library.

WE have already called attention to the Yellow Fever Institute, organized under the direction of the supervising surgeon general of the U. S. Marine Hospital Service. The work of the Institute has been divided into four sections by which the following topics will be investigated:

SECTION A.—HISTORY AND STATISTICS.

Topic 1. The early history of the disease.

Topic 3. History of recent epidemics (since 1850).

Topic 4. Relation to modern sanitation, especially paving, drainage, etc., in cities.

Topic 5. Why did not New Orleans have it in early times while Boston did?

Topic 6. Mortality statistics.

Topic 7. Maps showing yellow fever zones.

Topic 8. Maps showing the infectible territory in the United States.

SECTION B.—ETIOLOGY.

Topic 1. The cause of the disease.

SECTION C.—TRANSMISSION.

Topic 1. The transmission of the disease by the mosquito.

Topic 2. Can any other mosquito than the *Stegomya fasciata* carry the infection?

Topic 3. Is the progeny of the mosquito also infected?

Topic 4. How many generations?

Topic 5. Can the mosquito become infected by any other means than by sucking the blood of a patient sick with the disease?

Topic 6. Can the mosquito become infected by contact with the dried blood discharges or other infected materials upon fomites?

Topic 7. Can the disease be transmitted by any other means than through the mosquito?

Topic 8. Can the disease be conveyed by fomites, or through the air, soil or water?

Topic 9. The geographical distribution of *Stegomya fasciata* in relation to the disease.

Topic 10. Is the immunity enjoyed by certain localities due to the absence of this variety of mosquito?

Topic 11. A study of the life and habits of the *Stegomya* and allied species, especially with a view to their extermination.

SECTION D.—QUARANTINE AND TREATMENT.

Topic 1. Is disinfection of baggage necessary to prevent the spread of the disease?

Topic 2. Is any treatment of baggage necessary?

Topic 3. Mosquitoes in baggage, in merchandise, in cars, in ships.

Topic 4. Treatment of the patient.

Topic 5. Guards against mosquito bites.

Topic 6. Immunity of individuals, of races.

Topic 7. Individual prophylaxis.

Topic 8. Communal prophylaxis—sanitation.

THE Academy of Natural Sciences at Philadelphia announces the following Ludwick Institute Courses of Free Lectures. Each course contains five lectures and they are given in the evening. The courses are as follows:

Course I., Physiology and Hygiene, Seneca Egbert, A.M., M.D., professor of hygiene, Medico-Chirurgical College, Philadelphia. On Thursdays, beginning on November 7.

Course II., Entomology, Henry Skinner, M.D., conservator of the entomological section, Academy of Natural Sciences, Philadelphia. On Mondays, beginning on November 11.

Course III., Parasites and Parasitism, J. Percy Moore. On Thursdays, beginning on January 2.

Course IV., Structure and Life Histories of Some Common Birds, Witmer Stone, M.A., Conservator of the ornithological section, Academy of Natural Sciences, Philadelphia. On Mondays, beginning on January 6.

Course V., Sedimentary Rocks, their Origin and Formation, Amos P. Brown, Ph.D., professor of mineralogy and Geology, University of Pennsylvania, Philadelphia. On Thursdays, beginning on February 6.

Course VI., The Principles and Methods of Zoology, Philip Calvert, Ph.D., instructor in zoology, University of Pennsylvania. On Mondays, beginning on February 11.

Course VII., Studies of Plant Life in the Vicinity of Philadelphia, Stewardson Brown, conservator of the botanical section of the Academy of Natural Sciences, Philadelphia. On Thursdays, beginning on March 13.

Course VIII., Mollusks, Henry A. Pilsbury, conservator of the conchological section of the Academy of Natural Sciences, Philadelphia. On Mondays, beginning on March 17.

UNIVERSITY AND EDUCATIONAL NEWS.

A MEETING has been held in Halifax to consider a plan for the affiliation of the colleges in the provinces of Nova Scotia, New Brunswick, and Prince Edward Island, and the establishment of a university in the maritime provinces.

THE American residents of Montreal have given the sum of $9,000 to McGill University to found a political science fellowship in honor of the late President McKinley.

THE Berlin correspondent of the London *Times* states that the estimates for the army include a vote for the new military technical college which the Government proposes to open in the course of next year. The necessity for some such institution has been impressed upon the military authorities by the advancing scientific requirements of modern warfare, which are now too numerous and too varied to be adequately provided for by the resources at the command of the existing Staff College. There are branches of technical knowledge which, although they cannot strictly be classed as military, are, nevertheless, indispensable for the soldier. Among such subjects are steam-power, electricity, mechanics, the construction of boats and bridges, and the establishment of means of communication. In recognition of this fact the college which is shortly to be opened will have for its objects the extension of general technical knowledge in the army and also the special technical training of engineer officers, as well as of those officers who desire to prepare themselves there for a career in the railway, ballooning and other special departments of the service. The college will provide for the instruction of 200 officers, the course of study will be completed in three years, and the students will pass through three grades. One hundred officers will take the first year course, and of these 50 will subsequently proceed to the second and third grades. It is expected that the college will be opened on October 1, 1902. The ordinary annual expenses are estimated at 300,000 Marks.

PROFESSOR ADRIAN J. BROWN, director of the British School of Malting and Brewing, of Birmingham University, has issued a report in which he says that they have now more students than the laboratories ought to accommodate, and he has been compelled to refuse others who have applied for admission. There are 18 students at present working in the school, and of these 16 devote their whole time to their work.

FOUR students of the University of Pennsylvania have been awarded scholarships by the Institute for Medical Research, founded by Mr. John D. Rockefeller. Those receiving the scholarships are Dr. George H. Gildersleeve, of the hygienic laboratory, and E. B. Vedder, C. M. Duval and Dr. F. P. Gray, of the pathological laboratory.

MR. WILLIAM MAXWELL REED has been appointed assistant professor of astronomy at Princeton University to fill the position left vacant by Mr. Taylor Reed.

MISS EDITH M. TEWKESBURY, B.A. (Wellesley), has been appointed instructor in chemistry at Wells College.

THOMAS SHAW, professor of animal industry at the Minnesota State Agricultural College, has resigned to become editor of an agricultural journal.

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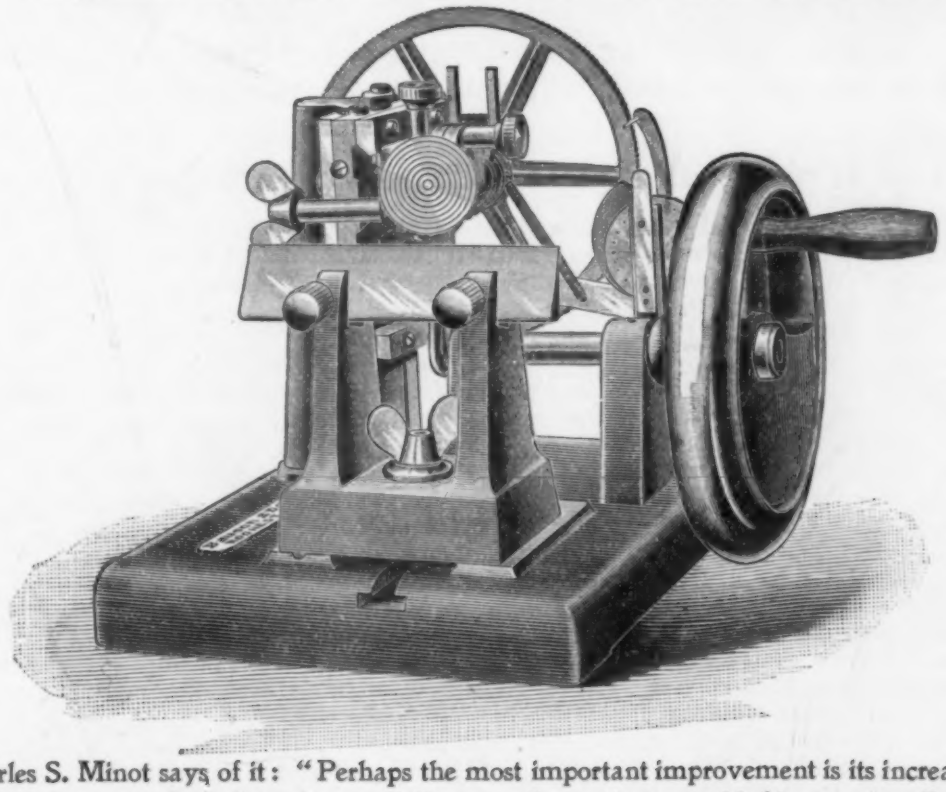

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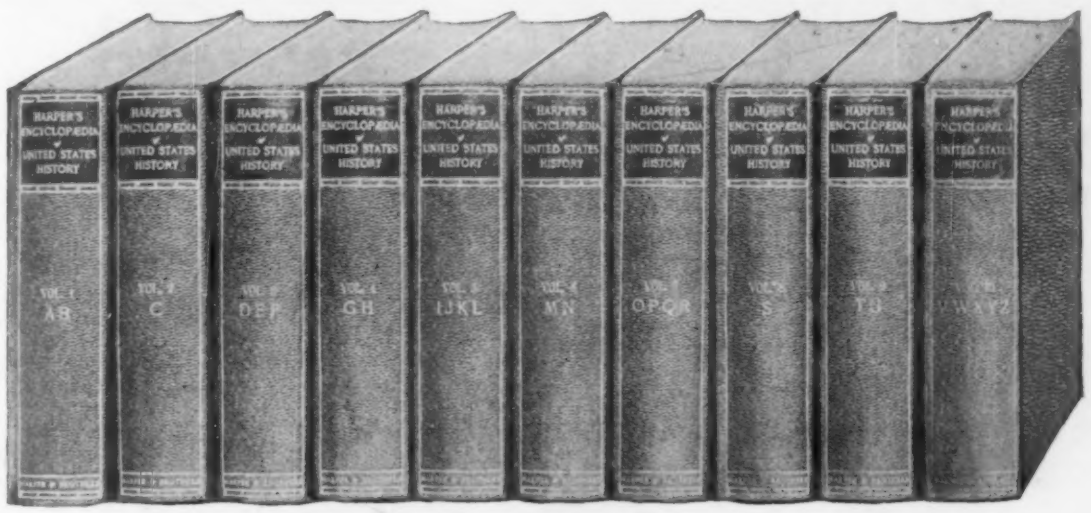

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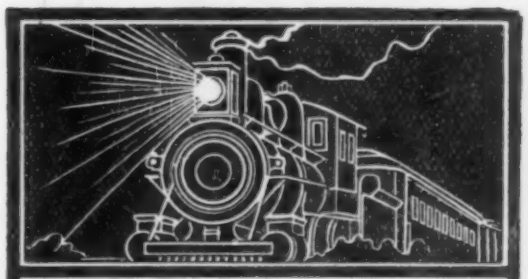

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